SOURCE ABSTRACT TEMPLATE

N69BLA04RMUS

~~TENTATIVE~~ SOURCE CODE: INITIALS:

ABSTRACT:

SUBJECT CHECKOFFS (circle all those that apply):

Community
Terrestrial Community
Forest
Savanna
Grassland
Shrubland
Desert
Alpine
Other Terrestrial Communities
Aquatic Communities
Subterran
Siteinfo
Flora: Aquat./ Terr./ Nonvasc./ Vasc.
Palustrine / Lacustrine / Riverine
Fauna: Aquat./ Terr.
Physical Science
Physiographic Features
Hydrology / Geology / Biology / Ecology
Research Techniques
Environmental Impact Studies
Ecosystem Functions
Natural Diversity
Inventory
Soils
Climate

ADDITIONAL CHECKOFFS:

KEYWORDS (circle all those that apply):

Age-Size Structure
Autecology
Baseline Study
Bibliography
Biogeography
Climatology
Classification
Community Analysis
Disturbance
Diversity Pattern
Early Exploration
Fire
GIS
Gradient Analysis
Grazing
Habitat Type
Map
Model
Paleoecology
Relict Vegetation
Remote Sensing
Riparian
Soil-Vegetation Relationship
Succession
Wetland
Woodland
Zonation

NEW KEYWORDS (if none of the above apply):

~~Author~~

Copy Title Contents
pages 1-41, 42-66 + Table + Map

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VEGETATION AND SOILS

of

CRANE SPRINGS WATERSHED

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and

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Map - Crane Springs Watershed

INTRODUCTION

The Crane Springs Watershed is located in western Elko County about 15 airline miles southwest of Elko, Nevada (Fig. 1).

The basin is within the Elko District of the Bureau of Land Management. It consists of approximately 17,920 acres (28 square miles). The watershed lies within the north central part of the Basin and Range Physiographic Province and consists of north-south trending mountains separated by small valleys (Hunt, 1967). The altitude of the highest peak is around 6800 feet and the basin outlet is approximately 5200 feet. Relief between the mountains and adjoining valleys rarely exceeds 1000 feet.

Geologic parent material consist mainly of sandstone and alluvium with some dolomite and andesite.

Water in the basin flows briefly in ephemeral streams from snow melt or thunderstorms. Drainage is to the Humboldt River.

The climate of the basin is semi-arid. Annual precipitation for a 4-year period (1965 through 1968) ranged from 7.8 to 15.8 inches. Comparisons with known records at Elko indicated one below average, and three above average precipitation years. The months which receive more than 1.0 inch of moisture are November, December, March, April, May, June and August (Fig. 2).

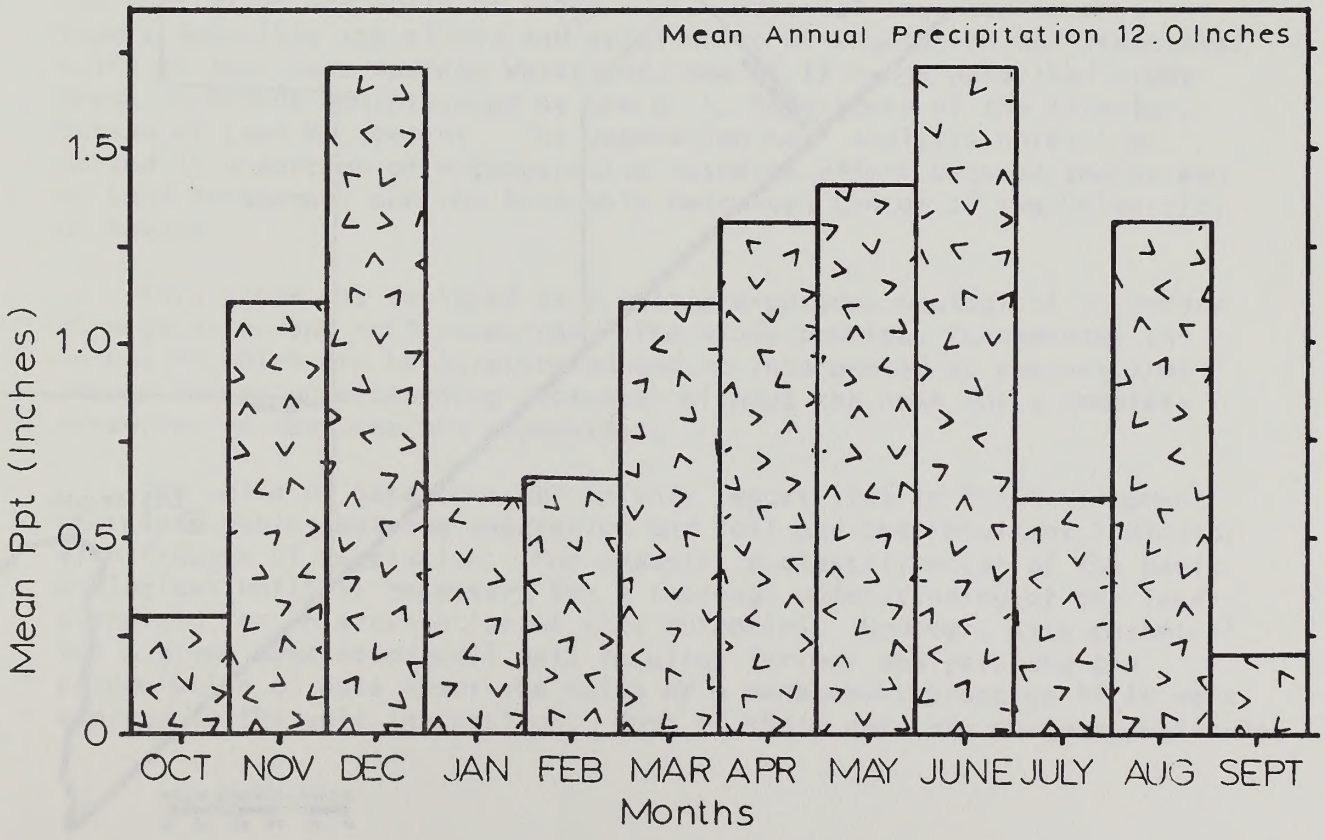

Figure 2 Mean Monthly Precipitation For Crane Springs Watershed

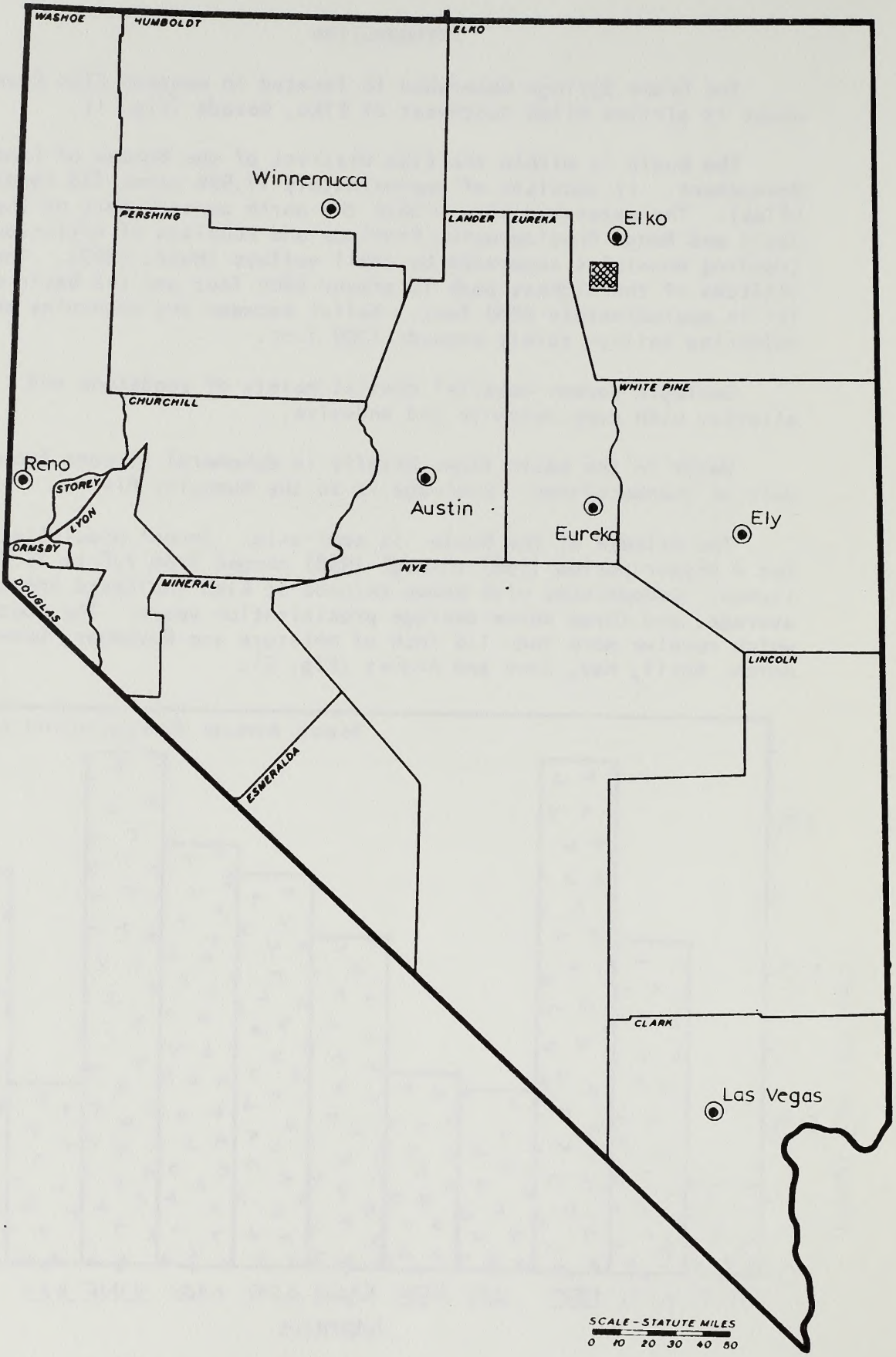

Figure 1. ▩ Location Of Crane Springs Watershed In Nevada

During the period 1870 to 1968, the approximate temperature of the lower elevations of the watershed ranged from a low of -42°F to a high of 107°F with the average annual temperature of 45.4°F.

Three vegetation zones are represented in the watershed: northern desert shrub, salt desert shrub and juniper. Soils are mostly Aridisols although some Mollisols and Entisols are found.

In the late 1930's and early 1940's large bands of sheep used the general area of the watershed. For a number of years up to 100 head of horses grazed the area. At present, the basin is used by approximately 2300 head of cattle during most of the summer.

In the fall of 1967 a majority of the northern part of the watershed was plowed and drilled to crested wheatgrass.

Two wells have been drilled in the watershed for livestock water.

Wildlife is not abundant in the area and primarily consists of mule deer.

Recreation use is low. The few annual visitors are primarily interested in hunting.

Land managers constantly require factual information on which to base their programs. There is a special need for detailed data about the vegetation and soils on rangelands. Material included in this report describes the climax and seral units of vegetation and associated soils in the Crane Springs Watershed, one of 12 range watershed study areas in Nevada administered by the U. S. Department of the Interior, Bureau of Land Management. The vegetation-soil analysis herein reported is a portion of a cooperative research effort between the Bureau of Land Management and the Renewable Resources Center of the University of Nevada.

This study was designed as a multiple-purpose ecological inventory of vegetation and soil resources. The study provides fundamental information which can be interpreted and re-interpreted as use patterns change and as understanding increases without the need for a complete re-survey as new uses are emphasized.

The value of data outlined in this report lies in the development of relationships between vegetation and soil and the resultant indicator significance of vegetation. For example, a classification of the basic ecological units is necessary for a thorough understanding of the landscape and for interpretation of site potential. However, site potential for a given vegetation-soil unit requires further analysis and the accumulation of data about the value of a management practice if it were applied to the unit in question. Much of these data are not yet available.

Management recommendations are curtailed due to a lack of data relating to vegetation-soil units described herein. When such data become available, however, the land manager will be able to easily identify sites within the confines of his unit of responsibility upon which a given practice or management program has been found desirable. An enhanced ability to precisely define range landscapes constitutes the real value of this analysis.

We have attempted to define the vegetation-soil units on the basis of a habitat-type classification. A habitat-type, as defined by Daubenmire (1952) is "the collective area which is capable of supporting the same homogeneous climax plant association." Collective area means a unique ecological entity which can be delineated on a map or aerial photograph. The habitat-type concept indexes site potential since it is an expression of the ultimate unit of the sum environment with regard to vegetation, soil classification unit, topographic placement and, by inference, micro- and mesoclimatic factor.

As an example, we have interpreted the *Juniperus osteosperma* community to be a habitat-type based on its homogeneity, recurrence, productivity, relict areas, and apparent equilibrium with its environment. When a community is not climax, careful evaluation of plant, soil, physiographic and climatological data is necessary in order to speculate as to the probable habitat-type with its specific potential. The *Chrysothamnus viscidiflorus/Poa secunda* community is an example of seral vegetation. This community occurred on similar soil with similar physiographic placement and climate as *Artemisia tridentata/Agropyron spicatum* stands found elsewhere. On these bases, the *Chrysothamnus viscidiflorus/Poa secunda* community was interpreted to be an *Artemisia tridentata/Agropyron spicatum* habitat-type. Similar evaluations have been made for most of the communities recognized in the watershed.

The first section of this report is a key to the 15 plant communities. This key refers the reader to the second section, a detailed description of each community. The third section is devoted to a discussion of management suitabilities and ecology of the watershed. This is followed by the appendices which contain precipitation data, soil families and sub-groups associated with the watershed plant communities, vegetation and soil association table. Finally a watershed map illustrates mapping units which consist of plant communities with their respective percentage indicated; roads, precipitation gages, townships, ranges and sections.

Methodology

The vegetation of the Crane Springs Watershed was delineated into plant communities during a reconnaissance. As a general rule, all communities were recognized and delineated on the basis of vegetative characteristics alone. Then as soil and physiographic data were accumulated, this initial delineation was re-evaluated on several occasions until the 15 plant communities described in this report were finally identified and interpreted. These communities were given names corresponding to the major dominant and major sub-dominant species.

Basal Area and Cover Data

After the plant communities were delineated, an intensive study was initiated by an adaptation of methods described by Poulton and Tisdale (1960) and further modified by Tueller (1962).

A 100-foot-square macroplot was used. Five plots were considered ample to adequately describe a community (Eckert, 1957) but on minor or inaccessible communities, only one or two plots were used.

Permanent macroplots were established by running a 100-foot baseline up and down the slope. Plots placed on the level were oriented north and south.

Within each macroplot, four 4- x 50-foot belt transects were randomly located perpendicular to the baseline. Randomization was restricted to prevent transect overlap and to provide for two transects each in the upper and lower half of the plots. This two-way randomization provides for adequate sampling of the full length of the macroplot (Eckert, 1957).

Each belt transect was divided into ten 4- x 5-foot plots thus enabling forty 4- x 5-foot plots to be studied in each macroplot. Two kinds of data were obtained from each plot: (1) basal area of the more abundant grasses and forbs, and (2) crown cover estimates of shrubs, A 1-square-foot frame was used as an estimation guide for both basal area and crown cover data.

Basal area was selected because it is relatively free from yearly weather variations and grazing influences (Tueller, 1962). Dead centers which exceeded 25 percent of the area of bunchgrasses were excluded from the estimate. Basal area estimates by species were based on the following cover classes (Poulton, 1962):

Class	Class Range Percent	Midpoint Percent
1	0 - 1	0.5
2	1+ - 5	2.5
3	5+ - 10	7.5
4	10+ - 25	17.5
5	25+ - 50	37.5
6	50+ - 75	62.5
7	75+ - 95	85.0
8	95+ - 100	97.5

The midpoint of each class range was used in calculating cover percentage.

Shrub crown cover estimates were obtained by standing directly over the shrub and projecting the foliage cover onto the ground. Estimates were made for each species to the nearest 1 percent of the 4- x 5-foot plot. Openings in the canopy larger than one-quarter of a square foot were not included.

Tree Density and Cover Data

Crown cover data of trees were obtained from a 66- x 132-foot plot. Trees found within the plots were counted by species and 10 typical tree crowns were measured. From this information the density (trees/acre) and average tree cover was computed for each species by plot.

Frequency Data

Frequency, according to Cain and Castro (1959), is percent presence in plots of a stated size. For example, if a sample of a stand consists of 200 plots, and if one or more plants of a given species occurs in 50 of these plots, the species has a frequency percentage of 25.

Frequency sampling procedures developed by Hyder et al. (1963) were used to supplement cover estimates on each macroplot. Although frequency data are difficult to interpret, the speed and objectivity inherent in the method makes them useful when comparing areas where high statistical precision is needed (Tueller, 1962). Ten frequency transects, each with 20 presence or absence determination quadrats, were located perpendicular to the baseline. Each transect consisted of twenty 20- x 20-inch or 30- x 30-inch quadrats placed contiguously and moving away from the baseline. Only those plants rooted inside the frequency quadrats were recorded. A two-stage randomization was applied to these transects: (1) restricting five transects to each half of the macroplot, and (2) preventing transect overlap.

Non-living Ground Cover. Nonliving ground cover was determined by an adaptation of the point frame method as described by Godall (1952). The same 200 frequency plots were used to sample cover but instead of recording presence of vegetation, the bottom tip end of the frequency frame was used as a point. Hits of bare ground, litter, pavement (1/4 to 1-inch diameter), rock (1-inch-plus diameter) and lichen cover, when present, were recorded.

Constancy. Cain and Castro (1959) define constancy as "the percentage of occurrence of a species on samples of the same size in various stands of a community type."

Species constancy percentages were calculated for each macroplot. In order to develop a complete species list for constancy, each 100- x 100-square-foot macroplot was examined carefully after obtaining cover and frequency data. Additional species encountered were added to the list.

Topographic and Physiographic Features. Topographic features of each macroplot were characterized as follows: position on the slope whether top, upper one-third, center one-third, lower one-third, or bottom, slope in percent obtained from an abney level, and aspect from an 8-point compass.

Physiographic placement of each macroplot was characterized as follows: land form - drainage bottom, escarpment, fan,floodplain, plateau, flooded depression, ridge top, slope, lake-marine, or river terrace; macrorelief - flat, undulating, rolling, butte, hilly, or mountainous; microrelief - uniform-flat, convex, concave, interrupted-mount, pits, ridge and swale.

Soils Study - A soil profile description was made at each macroplot using the procedures outlined in the Soil Survey Manual (1951) and the Seventh Approximation (1960) plus revisions (1967). Horizons, soil color, texture, pH, lime content, structure and consistence were noted for each profile.

Lack of time and money prevented complete laboratory soil analyses. The following parameters were selected because they have been suggested to be indicative of vegetation and soil relationships (Eckert, 1957). Samples from the A1 and B2 horizons were analyzed for conductivity (millimhos per centimeter), pH (from a saturated paste), and organic matter (percent). Cation exchange capacity (milliequivalents per 100 grams) was determined only on those samples from the A1 horizon (USDA Handbook No. 60, 1954).

Family level identifications were made as found in the Seventh Approximation (1960) and revisions (1967). When more than one profile description per family occurred, the modal description was used noting that family.

Each soil was classified as to hydrologic group (Nevada Dept. of Conservation and Natural Resources and the USDA, 1965); stoniness (USDA, 1951); and estimated water holding capacity based on clay mineralogy and texture (Schokley, 1955). Available water holding capacity was estimated for the rooting depth or to the depth of the soil profile studied if not otherwise stated. Rooting depths were limited by duripans and lithic or paralithic contacts.

Soil boundaries were not physically located and a soil map was not made. Thus detailed comparisons of soils across the boundary were not possible or within the scope of this study. Only the soils at the macroplots were described. The kinds of soils noted at the macroplots are commonly associated with the different kinds of vegetation in this watershed.

Erosion - Current erosion of each vegetation-soil unit was classified (USDA, 1964).

Climatic Data - Precipitation data were taken for a 4-year period from non-recording rain gages placed throughout the watershed. The data were then related to each applicable community in inches of annual precipitation.

Temperatures were estimated from existing records at Elko, located about 15 airline miles to the northeast. It has a climate similar to that of the lower elevations of the watershed.

KEY TO THE PLANT COMMUNITIES
in the
CRANE SPRINGS WATERSHED

A. Communities with a *Juniperus osteosperma* overstory.

B. *Chrysothamnus viscidiflorus* abundant in the shrub layer.

C. *Agropyron smithii* most abundant grass.....*Juniperus osteosperma/Chrysothamnus viscidiflorus/Agropyron smithii* Community ..... (P.39)

CC. *Bromus tectorum* most abundant grass.....*Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* Community..... (P.41)

BB. *Chrysothamnus viscidiflorus* not abundant in the shrub layer.

C. *Artemisia nova* understory.....*Juniperus osteosperma/Artemisia nova/Bromus tectorum* Community..... (P.37)

CC. *Juniperus osteosperma* forming a closed community... .....*Juniperus osteosperma* Community..... (P.35)

AA. Communities without a *Juniperus osteosperma* overstory.

B. *Artemisia* overstory.

C. *Artemisia arbuscula* or *Artemisia nova* overstory.

D. *Artemisia arbuscula* overstory with *Poa secunda* abundant in the understory.....*Artemisia arbuscula/Poa secunda* community..... (P.11)

DD. *Artemisia nova* overstory with *Bromus tectorum* abundant in the understory.....*Artemisia nova/Bromus tectorum* Community..... (P.13)

CC. *Artemisia tridentata* overstory.

D. *Chrysothamnus viscidiflorus* abundant in the shrub layer.

E. *Elymus cinereus* abundant in the understory.... *Artemisia tridentata/Chrysothamnus viscidiflorus/Elymus cinereus* Community..... (P.19)

EE. *Poa secunda* abundant in the understory...
...*Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda* Community..... (P.21)

DD. Not as above.

E. Grasses or sedges forming an understory beneath *Artemisia tridentata.*

F. *Bromus tectorum* abundant in the understory..
....*Artemisia tridentata/Bromus tectorum* Community..... (P.15)

FF. *Carex* sp. abundant in the understory....
Artemisia tridentata/Carex sp./*Bromus tectorum* Community..... (P.17)

FFF. *Elymus cinereus* abundant in the understory
.....*Artemisia tridentata/Elymus cinereus/Bromus tectorum* Community..... (P.23)

BB. *Chrysothamnus viscidiflorus* overstory.

C. *Agropyron smithii* and *Elymus cinereus* abundant in the understory.....*Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus* Community..... (P.29)

CC. *Elymus cinereus* abundant in the understory.....
Chrysothamnus viscidiflorus/Elymus cinereus Community.. (P.31)

CCC. *Poa secunda* abundant in the understory....
Chrysothamnus viscidiflorus/Poa secunda Community..... (P.33)

BBB. *Atriplex confertifolia* overstory with *Bromus tectorum* abundant in the understory....*Atriplex confertifolia/Bromus tectorum* Community..... (P.27)

Low Sagebrush *(Artemisia arbuscula)* Community

1. *Artemisia arbuscula/Poa secunda* Community

This community has developed in the southeast part of the watershed as small inclusions within the *Artemisia tridentata/Carex* sp./*Bromus tectorum* community. The community occurs on north facing slopes of 6 percent, elevation is around 6300 feet. The mean annaul precipitation is 12.7 inches (Appendix A).

Low sagebrush *(Artemisia arbuscula)* is the dominant species with 5.0 percent cover and 50.0 percent frequency.

Sandberg bluegrass *(Poa secunda)* is the most abundant grass (1.5 percent cover and 60.0 percent frequency). Cheatgrass *(Bromus tectorum)*, squirreltail *(Sitanion hystrix)*, Webber ricegrass *(Oryzopsis webberi)*, and Thurber needlegrass *(Stipa thurberiana)* occur with frequency percents of 45.0, 30.0, 20.0 and 5.0, respectively.

Longleaf phlox *(Phlox longifolia)* and Crag aster *(Aster scopulorum)* are the most frequent forbs with 35.0 and 20.5 percent, respectively. *Senecio integgerimus* and low pussytoes *(Antennaria dimorpha)* occur with frequency values of 15.0 and 5.0 percent, respectively (Table 1). This community is probably a seral representative of an *Artemisia arbuscula/Oryzopsis webberi* habitat-type.

Litter accounts for 47.5 percent of the non-living ground cover, pavement for 25.0 percent, bare ground for 22.0 percent and rock for 5.5 percent (Table 2).

The soil at the macroplot where this community was sampled is a member of a very-fine, montmorillonitic, frigid family of Mollic Paleargids (Appendix B-14).

Table 1. Species Cover and Frequency for the *Artemisia arbuscula/Poa secunda* Community

Species	Cover %	20 x 20* Frequency %
Artemisia arbuscula	5.0	50.0
Poa secunda	1.5	60.0
Bromus tectorum		45.0
Sitanion hystrix		30.0
Oryzopsis webberi		20.0
Stipa thurberiana		5.0
Phlox longifolia		35.0
Aster scopulorum		20.5
Senecio integerrimus		15.0
Antennaria dimorpha		5.0

*Frame size in inches

Table 2. Non-living Ground Cover for the *Artemisia arbuscula/Poa secunda* Community

Material	Cover %
Bare ground	22.0
Litter	47.5
Pavement	25.0
Rock	5.5

Black Sagebrush *(Artemisia nova)* Community

1. *Artemisia nova/Bromus tectorum* Community

This small community has developed on mountain slopes in the northern end of the watershed. It is found on south facing slopes of 10 to 25 percent, elevation is around 5400 feet. The mean annual precipitation is 11.4 inches (Appendix A).

Black sagebrush *(Artemisia nova)* is the dominant shrub with 20.5 percent cover and 78.5 percent frequency. Bud sagebrush *(Artemisia spinescens)* and shadscale *(Atriplex confertifolia)* occur with cover values of 0.7 and 0.4 percent, and frequency values of 10.5 and 11.5 percent, respectively.

Cheatgrass *(Bromus tectorum)* and squirreltail *(Sitanion hystrix)* occur with 0.4 and 0.4 percent cover and 56.3 and 17.5 percent frequency, respectively. Sandberg bluegrass *(Poa secunda)* is found with 2.0 percent frequency.

Halogeton *(Halogeton glomeratus)* occurs with 9.8 percent frequency (Table 3). This community is probably a seral representative of an *Artemisia nova/Oryzopsis hymenoides* habitat-type.

Litter accounts for 44.0 percent of the ground cover characteristics, lichen for 28.0 percent, pavement for 13.0 percent, bare ground for 12.5 percent and rock for 2.5 percent (Table 4).

The soil at the macroplot where this community was sampled is a member of a loamy-skeletal, mixed, mesic family of Lithic Mollic Haplargids (Appendix B-12).

Table 3. Species Cover and Frequency for the *Artemisia nova/Bromus tectorum* Community

Species	Cover %	30 x 30* Frequency %
Artemisia nova	20.5	78.5
Artemisia spinescens	0.7	10.5
Atriplex confertifolia	0.4	11.5
Bromus tectorum	0.4	56.5
Sitanion hystrix	0.4	17.5
Poa secunda		2.0
Halogeton glomeratus		9.0

* Frame size in inches

Table 4. Ground Cover Characteristics for the *Artemisia nova/Bromus tectorum* Community

Material	Cover %
Bare ground	12.5
Litter	44.0
Pavement	13.0
Rock	2.5
Lichen	28.0

Big Sagebrush *(Artemisia tridentata)* Community

1. *Artemisia tridentata/Bromus tectorum* Community

This community is found on hills and alluvial fans in the northern part of the watershed. It occurs on north, northeast, southwest and west facing fans and slopes with 1 to 37 percent slope, elevation ranges from 5250 to 5450 feet. The mean annual precipitation is 11.3 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* is the dominant species with 16.1 percent cover and 49.9 percent frequency. Rubber rabbitbrush *(Chrysothamnus nauseosus)* and yellowbrush *(Chrysothamnus viscidiflorus)*, when present, occurs with 0.4 percent frequency.

Cheatgrass *(Bromus tectorum)* and squirreltail *(Sitanion hystrix)* are the most frequent grasses, 37.7 and 17.7 percent, respectively and 100 percent constancy. Sandberg bluegrass *(Poa secunda)*, Indian ricegrass *(Oryzopsis hymenoides)* and Great Basin wildrye *(Elymus cinereus)* occur with 0.2 to 2.0 percent frequency, and 33 to 67 percent constancy.

Thickstem wildcabbage *(Caulanthus crassicaulis)* is the most abundant forb with 5.0 percent frequency and 56 percent constancy. A number of additional forbs occur with a trace to 2.3 percent frequency and 11 to 22 percent constancy (Table 5). This community is probably a seral representative of an *Artemisia tridentata/Elymus cinereus* habitat-type.

Litter accounts for 58.2 percent of the non-living ground cover, bare ground for 40.1 percent, pavement for 0.9 percent, and rock for 0.8 percent (Table 6).

The soils at the macroplots where this community was sampled are members of a sandy, mixed, frigid family of Typic Torripsamments (Appendix B-2); coarse-loamy, mixed, frigid family of Typic Torriorthents (Appendix B-3); coarse-loamy, mixed, frigid family of Duric Mollic Camborthids (Appendix B-10); fine-loamy, mixed, frigid family of Duric Mollic Haplargids (Appendix B-13); and a coarse-loamy, mixed, mesic family of Mollic Camborthids (Appendix B-9).

Table 5. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Bromus tectorum* Community

Species	Cover %	30 x 30* Frequency %	Constancy %
Artemisia tridentata	16.1	49.9	100
Chrysothamnus nauseosus		0.4	33
Chrysotahmnus viscidiflorus		0.4	33
Bromus tectorum		37.7	100
Sitanion hystrix		17.7	100
Poa secunda		2.0	67
Oryzopsis hymenoides		0.5	44
Elymus cinereus		0.2	33
Caulanthus crassicaulis		5.0	56
Iva axillaris		2.3	11
Eriogonum sp.		0.3	22
Phlox diffusa		0.2	11
Eriastrum diffusum		0.1	22
Lepidium perfoliatum		0.1	22
Halogeton glomeratus		0.1	11
Arabis holboellii			11
Astragalus sp.			11
Chaenactis douglasii			11
Sphaeralcea coccinea			11

Frame size in inches.

Table 6. Non-living Ground Cover for the *Artemisia tridentata/Bromus tectorum* Community

Material	Cover %
Bare ground	40.1
Litter	58.2
Pavement	0.9
Rock	0.8

2. *Artemisia tridentata/Carex* sp./*Bromus tectorum* Community

This small community has developed on hills in the southwest part of the watershed. It occurs on east facing slopes of 8 percent, elevation is around 6300 feet. The mean annual precipitation is 12.5 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* is the dominant species with 8.6 percent cover and 26.5 percent frequency. Yellowbrush *(Chrysothamnus viscidiflorus)* occurs with a frequency of 6.5 percent.

Cheatgrass *(Bromus tectorum)*, Sandberg bluegrass *(Poa secunda)* and bluestem wheatgrass *(Agropyron smithii)* are the most frequent grasses with 57.5, 25.5 and 21.5 percent, respectively. Great Basin wildrye *(Elymus cinereus)*, Thurber needlegrass *(Stipa thurberiana)* and Indian ricegrass *(Oryzopsis hymenoides)* occur with frequency values of 2.5 to 4.5 percent. Sedge *(Carex* sp.) is abundant in the understory (7.6 percent cover and 53.0 percent frequency).

Scarlet globemallow *(Sphaeralcea coccinea)* is the most frequent forb with 3.5 percent. A few additional forbs occur with 0.5 to 2.0 percent frequency (Table 7). This community is probably a seral representative of an *Artemisia tridentata/Agropyron smithii/ Carex* sp. habitat-type.

Litter accounts for 77.5 percent of the non-living ground cover, bare ground for 21.5 percent, pavement for 0.5 percent, and rock for 0.5 percent (Table 8).

The soil at the macroplot where this community was sampled is a member of a very-fine, montmorillonitic, frigid family of Typic Argixerolls (Appendix B-16).

Table 7. Species Cover and Frequency for the *Artemisia tridentata/Carex* sp./*Bromus tectorum* Community

Species	Cover %	20 x 20* Frequency %
Artemisia tridentata	8.6	26.5
Chrysothamnus viscidiflorus		6.5
Bromus tectorum		57.5
Poa secunda		25.5
Agropyron smithii		21.5
Elymus cinereus		4.5
Stipa thurberiana		3.0
Oryzopsis hymenoides		2.5
Carex sp.	7.6	53.0
Sphaeralcea coccinea		3.5
Lupinus caudatus		2.0
Eriastrum diffusum		0.5
Gayophytum ramoisissimum		0.5

*Frame size in inches

Table 8. Non-living Ground Cover for the *Artemisia tridentata/Carex* sp./*Bromus tectorum* Community

Material	Cover %
Bare ground	21.5
Litter	77.5
Pavement	0.5
Rock	0.5

3. *Artemisia tridentata/Chrysothamnus viscidiflorus/ Elymus cinereus* Community

This community is located in the northeast part of the watershed. It is found on west and northwest facing alluvial fans and drainage bottoms with 2 to 4 percent slope, elevation ranges from 5200 to 5700 feet. The mean annual precipitation is 12.0 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* and yellowbrush *(Chrysothamnus viscidiflorus)* are the dominant species with 8.6 and 8.4 percent cover, and 37.1 and 34.6 percent frequency. Additional shrubs occur with 0.1 to 0.2 percent frequency and 17 to 50 percent constancy.

Great Basin wildrye *(Elymus cinereus)*, cheatgrass *(Bromus tectorum)* and squirreltail *(Sitanion hystrix)* are the most frequent grasses with 15.8, 32.3 and 19.7 percent with Great Basin wildrye the dominant (3.2 percent cover). Sandberg bluegrass *(Poa secunda)*, Indian ricegrass *(Oryzopsis hymenoides)*, bluestem wheatgrass *(Agropyron smithii)* and needle-and-thread grass *(Stipa comata)* occur with a frequency of 0.3 to 13.2 percent, and constancy of 33 to 100 percent.

Phlox diffusa is the most frequent forb with 6.2 percent. Other forbs occur with a trace to 0.9 percent frequency, and 17 to 83 percent constancy (Table 9). This community is probably an *Artemisia tridentata/Elymus cinereus* habitat-type.

Litter accounts for 55.6 percent of the non-living ground cover, bare ground for 42.6 percent, pavement for 1.6 percent and rock for 0.2 percent (Table 10).

The soils at the macroplots where this community was sampled are members of a coarse-loamy, mixed, frigid family of Duric Mollic Camborthids (Appendix B-7).

Table 9. Species Cover, Frequency, and Constancy for the *Artemisia tridentata/Chrysothamnus viscidiflorus/ Elymus cinereus* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia tridentata	8.6	37.1	100
Chrysothamnus viscidiflorus	8.4	34.6	100
Chrysothamnus nauseosus		0.2	50
Eurotia lanata		0.2	33
Opuntia polyacantha		0.1	17
Elymus cinereus	3.2	15.8	100
Bromus tectorum		32.3	100
Sitanion hystrix		19.7	100
Poa secunda		13.2	83
Oryzopsis hymenoides		9.0	100
Agropyron smithii		6.5	67
Stipa comata		0.3	33
Phlox diffusa		6.2	83
Lepidium perfoliatum		0.9	67
Astragalus sp.		0.3	33
Sphaeralcea coccinea		0.3	33
Descurainia sophia		0.2	11
Eriastrum diffusum		0.1	33
Chaenactis douglasii		0.1	17
Arabis sp.			17
Cryptantha jamesii			17
Machaeranthera canescens			17

*Frame size in inches

Table 10. Non-living Ground Cover for the *Artemisia tridentata/Chrysothamnus viscidiflorus/ Elymus cinereus* Community

Material	Cover %
Bare ground	42.6
Litter	55.6
Pavement	1.6
Rock	0.2

4. *Artemisia tridentata/Chrysothamnus viscidiflorus/ Poa secunda* Community

This community has developed mostly in the southern part of the watershed. It occurs on west, southwest and east facing slopes and drainage bottoms with 2 to 8 percent slope. Elevation ranges from 5600 to 6800 feet. The mean annual precipitation is 11.8 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* and yellowbrush *(Chrysothamnus viscidiflorus)* are the dominant shrubs (10.4 and 7.1 percent cover, and 27.9 and 23.9 percent frequency, respectively. Winterfat *(Eurotia lanata)*, prickly phlox *(Leptodoctylon pungens)*, plains pricklypear *(Opuntia polyacantha)* and spiny hopsage *(Grayia spinosa)* occur with 0.1 to 1.8 percent frequency and constancy of 25 to 50 percent.

Sandberg bluegrass *(Poa secunda)*, cheatgrass *(Bromus tectorum)* and bluestem wheatgrass *(Agropyron smithii)* occur with 2.0, 2.0 and 0.7 percent cover, 38.4, 29.4 and 22.1 percent frequency, and 75, 50 and 75 percent constancy, respectively. Needle-and-thread grass *(Stipa comata)*, squirreltail *(Sitanion hystrix)*, Thurber needlegrass *(Stipa thurberiana)*, Great Basin wildrye *(Elymus cinereus)* and Indian ricegrass *(Oryzopsis hymenoides)* are found with frequency percents that range from 1.8 to 4.9 and constancy ratings that range from 25 to 100 percent.

Phlox diffusa is the most frequent (9.8 percent) and most constant (75 percent) forb. Other forbs are found in small erratic amounts (frequency 0.2 to 0.5 percent and constancy 25 to 50 percent (Table 1). This community is probably a seral representative of an *Artemisia tridentata/Elymus cinereus/Agropyron smithii* habitat-type.

Litter accounts for 54.8 percent of the non-living ground cover, bare ground for 44.3 percent, pavement for 0.9 percent and rock for 0.0 percent (Table 12).

The soils at the macroplots where this community was sampled are members of a sandy, mixed, frigid, family of Typic Torripsamments (Appendix B-2), and a coarse-loamy, mixed, frigid family of Duric Mollic Camborthids (Appendix B-7).

Table 11. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Chrysothamnus viscidiflorus/ Poa secunda* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia tridentata	10.4	27.9	100
Chrysothamnus viscidiflorus	7.1	23.9	100
Eurotia lanata		1.8	25
Leptodactylon pungens		0.8	
Opuntia polyacantha		0.2	50
Grayia spinosa		0.1	25
Poa secunda	2.0	38.4	75
Bromus tectorum	2.0	29.4	50
Agropyron smithii	0.7	22.1	75
Stipa comata		4.9	25
Sitanion hystrix		4.4	100
Stipa thurberiana		3.0	25
Elymus cinereus		2.9	100
Oryzopsis hymenoides		1.8	100
Phlox diffusa		9.8	75
Arabis holboellii		0.5	25
Sphaeralcea coccinea		0.5	25
Lupinus sp.		0.4	25
Chaenactis douglasii		0.2	50
Astragalus purshii			25

*Frame size in inches

Table 12. Non-living Ground Cover for the *Artemisia tridentata/Chrysothamnus viscidiflorus/ Poa secunda* Community

Material	Cover %
Bare ground	44.3
Litter	54.8
Pavement	0.9
Rock	0.0

5. *Artemisia tridentata/Elymus cinereus/Bromus tectorum* Community

This community has developed in the north central part of the watershed. It occurs on west and southwest facing drainage bottoms and terraces with 2 to 3 percent slope, elevation ranges from 5300 to 5700 feet. The mean annual precipitation is 11.4 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* is the dominant species with 12.3 percent cover and 40.6 percent frequency. Yellowbrush *(Chrysothamnus viscidiflorus)*, rubber rabbitbrush *(Chrysothamnus nauseosus)*, winterfat *(Eurotia lanata)* and plains prickly pear *(Opuntia polyacantha)* occur with 0.1 to 2.6 percent frequency and 17 to 50 percent constancy.

Great Basin wildrye (*Elymus cinereus)* and cheatgrass *(Bromus tectorum)* are the most abundant grasses (4.4 and 3.8 percent cover, and 29.2 and 64.0 percent frequency, respectively). Squirreltail *(Sitanion hystrix)*, Sandberg bluegrass *(Poa secunda)*, bluebunch wheatgrass *(Agropyron spicatum)*, Indian ricegrass *(Oryzopsis hymenoides)* and Nevada bluegrass (*Poa nevadensis)* are found with frequency of 0.7 to 27.8 percent, and constancy of 17 to 100 percent.

Thickstem wild cabbage *(Caulanthus crassicaulis)* and *Phlox diffusa* occur with 5.8 and 2.8 percent frequency and 33 percent constancy. Other forbs are found with 0.1 to 2.7 percent constancy (Table 13). This community is probably a seral representative of an *Artemisia tridentata/ Elymus cinereus* habitat-type.

Litter accounts for 58.3 percent of the non-living ground cover, bare ground for 40.2 percent, pavement for 0.4 percent and rock for 0.1 percent (Table 14).

The soils at the macroplots where this community was sampled are members of a coarse-loamy, mixed, frigid family of Duric Mollic Camborthids (Appendix B-7), and a coarse-loamy, mixed, frigid family of Mollic Camborthids (Appendix B-10).

Table 13. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Elymus cinereus/Bromus tectorum* Community

Species	Cover %	30 x 30* Frequency %	Constancy %
Artemisia tridentata	12.3	40.6	100
Chrysothamnus viscidiflorus		2.6	50
Chrysothamnus nauseosus		0.2	17
Eurotia lanata		0.1	17
Opuntia polyacantha		0.1	17
Elymus cinereus	4.4	29.2	100
Bromus tectorum	3.8	64.0	100
Sitanion hystrix		27.8	100
Poa secunda		4.6	83
Agropyron spicatum		3.2	17
Oryzopsis hymenoides		0.8	83
Poa nevadensis		0.7	17
Caulanthus crassicaulis		5.0	33
Phlox diffusa		2.8	33
Sphaeralcea coccinea		2.7	33
Lepidium perfoliatum		0.2	17
Chenopodium leptophyllum		0.1	17

* Frame size in inches

Table 14. Non-living Ground Cover for the *Artemisia tridentata/Elymus cinereus/Bromus tectorum* Community

Material	Cover %
Bare ground	40.2
Litter	59.3
Pavement	0.4
Rock	0.1

6. *Artemisia tridentata/Poa secunda/Elymus cinereus* Community

This community occurs in the south central part of the watershed as inclusions. It occurs on north facing drainage bottoms with 2 percent slope, elevation is around 5700 feet. The mean annual precipitation is 12.0 inches (Appendix A).

Big sagebrush *(Artemisia tridentata)* is the dominant species with 13.7 percent cover and 50 percent frequency. Yellowbrush *(Chrysothamnus viscidiflorus)*occurs with 3.9 percent cover and 13.5 percent frequency.

Sandberg bluegrass *(Poa secunda)* and Great Basin wildrye *(Elymus cinereus)* are abundant with 6.3 and 2.8 percent cover, and 67.5 and 23.0 percent frequency, respectively. Cheatgrass *(Bromus tectorum)*, squirreltail *(Sitanion hystrix)*, bluestem wheatgrass *(Agropyron smithii)* and Indian ricegrass *(Oryzopsis hymenoides)* are found with frequency that ranges from 1.0 to 56.0 percent.

Forbs were not encountered in the community (Table 15). This community is probably a seral representative of an *Artemisis tridentata/ Elymus cinereus* habitat-type.

Litter accounts for 52.5 percent of the non-living ground cover, bare ground for 47.5 percent, and pavement and rock for 0.0 percent (Table 16).

The soil at the macroplot where this community was sampled is a member of a coarse-loamy, mixed, frigid family of Entic Mollic Durorthids (Appendix B-11).

Table 15. Species Cover and Frequency for the *Artemisia tridentata/Poa secunda/Elymus cinereus* Community

Species	Cover %	20 x 20* Frequency %
Artemisia tridentata	13.7	50.0
Chrysothamnus viscidiflorus	3.9	13.5
Poa secunda	6.3	67.5
Elymus cinereus	2.8	23.0
Bromus tectorum		56.0
Sitanion hystrix		15.0
Agropyron smithii		3.5
Oryzopsis hymenoides		1.0

*Frame size in inches

Table 16. Non-living Ground Cover for the *Artemisia tridentata/Poa secunda/Elymus cinereus* Community

Material	Cover %
Bare ground	47.5
Litter	52.5
Pavement	0.0
Rock	0.0

Shadscale *(Atriplex confertifolia)* Community

1. *Atriplex confertifolia/Bromus tectorum* Community

This community occurs on hills and alluvial fans in the northern part of the watershed. It is found on south and west facing convex slopes with 2 to 37 percent, elevation ranges from 5350 to 5400 feet. The mean annual precipitation is 11.4 inches (Appendix A).

Shadscale *(Atriplex confertifolia)* is the dominant shrub with 3.6 percent cover and 32.8 percent frequency. Bud sagebrush *(Artemisia spinescens)* and plains prickly pear *(Opuntia polyacantha)* occur with 0.5 percent frequency.

Cheatgrass *(Bromus tectorum)* is the most abundant grass (2.2 percent cover and 63.8 percent frequency). Squirreltail *(Sitanion hystrix)*, Sandberg bluegrass *(Poa secunda)* and Indian ricegrass *(Oryzopsis hymenoides)*occur with frequency percent of 0.5 to 19.5.

Scarlet globemallow *(Sphaeralcea coccinea)* and James cryptantha *(Cryptantha jamesii)* occur with 6.8 and 6.0 percent frequency, respectively. Additional forbs are found with 0.5 to 4.8 percent (Table 17). This community is probably a seral representative of an *Atriplex confertifolia/Artemisia spinescens/Oryzopsis hymenoides* habitat-type.

Litter accounts for 38.8 percent of the non-living ground cover, bare ground for 29.0 percent, pavement for 25.4 percent and rock for 6.8 percent (Table 18).

The soils at the macroplots where this community was sampled are members of a loamy-skeletal, mixed, mesic family of Mollic Calciorthids (Appendix B-4) and a coarse-loamy, mixed, mesic family of Mollic Calciorthids (Appendix B-5).

Table 17. Species Cover, Frequency and Constancy for the *Atriplex confertifolia/Bromus tectorum* Community

Species	Cover %	30 x 30* Frequency %	Constancy %
Atriplex confertifolia	3.6	32.8	100
Artemisia spinescens		0.5	50
Opuntia polyacantha		0.5	50
Bromus tectorum	2.2	63.8	100
Sitanion hystrix		19.5	100
Poa secunda		1.0	100
Oryzopsis hymenoides		0.5	50
Sphaeralcea coccinea		6.8	100
Cryptantha jamesii		6.0	50
Halogeton glomeratus		4.8	100
Astragalus sp.		1.5	50
Eriogonum sp.		0.8	50
Eriastrum diffusum		0.5	50

*Frame size in inches

Table 18. Non-living Ground Cover for the *Atriplex confertifolia/Bromus tectorum* Community

Material	Cover %
Bare ground	29.0
Litter	38.8
Pavement	25.4
Rock	6.8

Yellowbrush *(Chrysothamnus vicidiflorus)* Communities

1. *Chrysothamnus vicidiflorus/Agropyron smithii/ Elymus cinereus* Community.

This community has developed in the eastern part of the watershed. It occurs on north facing fans with 4 percent slope, elevation is around 6000 ft. The mean annual precipitation is 12.2 inches (Appendix A).

Yellowbrush *(Chrysothamnus viscidiflorus)* is the dominant shrub with 12.1 percent cover and 44.5 percent frequency. Big sagebrush *(Artemisia tridentata)* is found with 1.5 percent frequency.

Bluestem wheatgrass *(Agropyron smithii)*, Great Basin wildrye *(Elymus cinereus)* and cheatgrass *(Bromus tectorum)* are the most abundant grasses with 10.6, 3.0 and 2.7 percent cover, and 79.0, 19.0 and 44.0 percent frequency, respectively. Sandberg bluegrass *(Poa secunda)*, squirreltail *(Sitanion hystrix)*, needle-and-thread grass *(Stipa comata)* and Indian ricegrass *(Oryzopsis hymenoides)* occur with frequency of 2.0 to 9.0 percent.

Phlox diffusa and Mohave eriogonum *(Eriogonum hermannii)* occur with 37.5 and 1.0 percent frequency, respectively (Table 19). This community is a seral representative of an *Artemisia tridentata/Elymus cinereus* habitat-type.

Litter accounts for 85.5 percent of the non-living ground cover, bare ground for 16.0 percent, pavement for 0.5 percent and rock for 0.0 percent (Table 20).

The soil at the macroplot where this community was sampled is a member of a coarse-loamy, mixed, frigid family of Duric Mollic Camborthids (Appendix B-7).

Table 19. Species Cover and Frequency for the *Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus* Community

Species	Cover %	20 x 20* Frequency %
Chrysothamnus viscidiflorus	12.1	44.5
Artemisia tridentata		1.5
Agropyron smithii	10.6	79.0
Elymus cinereus	3.0	19.0
Bromus tectorum	2.7	44.0
Poa secunda		9.0
Sitanion hystrix		3.5
Stipa comata		3.0
Oryzopsis hymenoides		2.0
Phlox diffusa		37.5
Eriogonum heermannii		1.0

*Frame size in inches

Table 20. Non-living Ground Cover for the *Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus* Community

Material	Cover %
Bare ground	16.0
Litter	83.5
Pavement	0.5
Rock	0.0

2. *Chrysothamnus viscidiflorus/Elymus cinereus* Community.

This community is found in the eastern part of the watershed. It occurs on west facing fans with 3 to 4 percent slope, and elevation ranges from 5200 to 5300 feet. The mean annual precipitation is 12.0 inches (Appendix A).

Yellowbrush *(Chrysothamnus viscidiflorus)* is the dominant species (18.6 percent cover and 43.0 percent frequency). Big sagebrush *(Artemisia tridentata)* and rubber rabbitbrush *(Chrysothamnus nauseosus)* occur with 9.8 and 0.8 percent frequency, respectively.

Elymus cinereus is the dominant grass (3.9 percent cover and 26.5 percent frequency). Bluestem wheatgrass *(Agropyron smithii)* is found with 42.5 percent frequency. Squirreltail *(Sitanion hystrix)*, Indian ricegrass *(Oryzopsis hymenoides)* and cheatgrass *(Bromus tectorum)* have frequency percents of 2.0 to 8.5.

Phlox diffusa is the most frequent forb with 16.5 percent. Additional forbs occur with 0.2 percent frequency (Table 21). This community is probably a seral representative of an *Artemisia tridentata/ Elymus cinereus* habitat-type.

Litter accounts for 53.2 percent of the non-living ground cover, bare ground for 26.5 percent, pavement for 18.8 percent and rock for 1.5 percent (Table 22).

The soils at the macroplot where this community was sampled are members of a sandy, mixed, frigid family of Typic Torripsamments (Appendix B-2).

Table 21. Species Cover, Frequency and Constancy for the *Chrysothamnus viscidiflorus/Elymus cinereus* Community

Species	Cover %	30 x 30* Frequency %	Constancy %
Chrysothamnus viscidiflorus	18.6	43.0	100
Artemisia tridentata		9.8	100
Chrysothamnus nauseosus		0.8	100
Elymus cinereus	3.9	26.5	100
Agropyron smithii		42.5	100
Sitanion hystrix		8.5	100
Oryzopsis hymenoides		3.0	100
Bromus tectorum		2.0	100
Phlox diffusa		16.5	100
Astragalus sp.		0.2	50
Cryptantha jamesii		0.2	50
Eriastrum diffusum		0.2	50
Lepidium perfoliatum		0.2	50

*Frame size in inches

Table 22. Non-living Ground Cover for the *Chrysothamnus viscidiflorus/Elymus cinereus* Community

Material	Cover %
Bare ground	26.5
Litter	53.2
Pavement	18.8
Rock	1.5

3. *Chrysothamnus viscidiflorus/Poa secunda* Community

This community occurs in the southwest part of the watershed. It is found on west facing slopes of 35 percent, elevation is around 5750 feet. The mean annual precipitation is 12.1 inches (Appendix A).

Yellowbrush *(Chrysothamnus viscidiflorus)* is the dominant shrub with 7.8 percent cover and 34.5 percent frequency. Big sagebrush *(Artemisia tridentata)* occurs with 2.3 percent cover and 9.0 percent frequency.

Sandberg bluegrass *(Poa secunda)* is the most abundant grass with 8.6 percent cover and 75.5 percent frequency. Squirreltail *(Sitanion hystrix)*, cheatgrass *(Bromus tectorum)*, bluebunch wheatgrass *(Agropyron spicatum)*, Thurber needlegrass *(Stipa thurberiana*, bluestem wheatgrass *(Agropyron smithii)*, Great Basin wildrye *(Elymus cinereus)* and Indian ricegrass *(Oryzopsis hymenoides)* occur with frequency of 1.5 to 27.5 percent.

Tailcup lupine *(Lupinus caudatus)* is the most frequent forb (12.0 percent) with other forbs occurring with 0.5 to 1.5 percent frequency (Table 23). This community is probably a seral representative of an *Artemisia tridentata/Agropyron spicatum* habitat-type.

Litter accounts for 67.5 percent of the non-living ground cover, bare ground for 27.0 percent, pavement for 5.0 percent and rock for 0.5 percent (Table 24).

The soil at the macroplot where this community was sampled is a member of a very-fine, montmorillonitic, frigid family of Typic Argixerolls (Appendix B-16).

Table 23. Species Cover and Frequency for the *Chrysothamnus viscidiflorus/Poa secunda* Community

Species	Cover %	20 x 20* Frequency %
Chrysothamnus viscidiflorus	7.8	34.5
Artemisia tridentata	2.3	9.0
Poa secunda	9.8	75.5
Sitanion hystrix		27.5
Bromus tectorum		25.5
Agropyron spicatum		5.0
Stipa thurberiana		4.0
Agropyron smithii		3.0
Elymus cinereus		2.0
Oryzopsis hymenoides		1.5
Luipnus caudatus		12.0
Lupinus sp.		1.5
Penstemon kingii		0.5

*Frame size in inches

Table 24. Non-living Ground Cover for the *Chrysothamnus viscidiflorus/Poa secunda* Community

Material	Cover %
Bare ground	27.0
Litter	67.5
Pavement	5.0
Rock	0.5

Juniper *(Juniperus osteosperma)* Communities

1. *Juniperus osteosperma* Community

This community occurs in the central part of the watershed where juniper forms a closed community. It is found on slopes of all aspects with 12 to 45 percent slope and elevation ranges from 5350 to 5700 feet. The mean annual precipitation is 12.3 inches (Appendix A).

Juniper *(Juniperus osteosperma)* occurs with an average density of 63.0 trees per acre and 19.6 percent cover. Rubber rabbitbrush *(Chrysothamnus viscidiflorus)* and bitterbrush *(Purshia tridentata)* are found with 1.3 and 0.2 percent frequency and 40 and 20 percent constancy, respectively.

Cheatgrass *(Bromus tectorum)*, Great Basin wildrye *(Elymus cinereus)* and squirreltail *(Sitanion hystrix)* are the most frequent grasses with 10.5, 4.8 and 4.1 percent, respectively. Needle-and-thread grass *(Stipa comata)*, Sandberg bluegrass *(Poa secunda)*, Indian ricegrass *(Oryzopsis hymenoides)*, pinewoods needlegrass *(Stipa pinetorum)* and Nevada bluegrass *(Poa nevadensis)* occur with 0.3 to 2.5 percent frequency.

Rannuculus sp. and James cryptantha *(Cryptantha jamesii)* are found with 4.6 and 3.3 percent frequency, and 60 and 80 percent constancy, respectively. Additional forbs occur with 0.1 to 2.9 percent frequency and 20 to 60 percent constancy (Table 25). This community is probably a *Juniperus osteosperma* habitat-type.

Bare ground accounts for 49.7 percent of the non-living ground cover, pavement for 25.0 percent, litter for 20.5 percent and rock for 4.8 percent (Table 26).

The soils at the macroplot where this community was sampled are members of a sandy-skeletal, mixed, frigid, shallow family of Typic Torripsamments (Appendix B-1).

Table 25. Species Density, Cover, Frequency and Constancy for the *Juniperus osteosperma* Community

Species	Density**	Cover %	20 x 20* Frequency %	Constancy %
Juniperus osteosperma	63.0	19.0	-	100
Chrysothamnus nauseosus			1.3	40
Purshia tridentata			0.2	20
Bromus tectorum			10.5	100
Elymus cinereus			4.8	100
Sitanion hystrix			4.1	100
Stipa comata			2.5	20
Poa secunda			1.9	40
Oryzopsis hymenoides			1.8	40
Stipa pinetorum			0.9	40
Poa nevadensis			0.3	20
Rannuculus sp.			4.6	60
Cryptantha jamesii			3.3	80
Astragalus sp.			2.9	60
Mentzelia sp.			1.9	40
Eriastrum diffusum			0.6	60
Phlox diffusa			0.6	40
Machaeranthera canescens			0.5	20
Castilleja chromosa			0.4	40
Eriogonum heermannii			0.4	20
Arabis holboellii			0.1	20
Chaenactis douglasii			0.1	20
Lepidium perfoliatum			0.1	20

* Frame size in inches
** Trees/acre

Table 26. Non-living Ground Cover for the *Juniperus osteosperma* Community

Material	Cover %
Bare ground	49.7
Litter	20.5
Pavement	25.0
Rock	4.8

2. *Juniperus osteosperma/Artemisia nova/Bromus tectorum* Community

This community has developed on hills in the northern part of the watershed. It is found on south facing slopes of 10 to 25 percent, elevation ranges from 5500 to 5650 feet. The mean annual precipitation is 11.4 inches (Appendix A).

Juniper *(Juniperus osteosperma)* occurs with 4.4 percent cover and a density of 35.0 trees per acre. Black sagebrush *(Artemisia nova)* is the dominant shrub with 18.6 percent cover and 76.5 percent frequency. Shadscale *(Atriplex confertifolia)* and bud sagebrush *(Artemisia spinescens)* are found with 12.5 and 8.0 percent frequency, respectively.

Cheatgrass *(Bromus tectorum)* is the most frequent grass with 45.5 percent. Squirreltail *(Sitanion hystrix)* and Sandberg bluegrass *(Poa secunda)* occur with 19.5 and 3.0 percent frequency, respectively. No forbs were observed in the community (Table 27). This community is probably a seral representative of a *Juniperus osteosperma/Artemisia nova/Oryzopsis hymenoides* habitat-type.

Litter accounts for 44.0 percent of the ground cover, lichen for 28.0 percent, pavement for 13.0 percent, bare ground for 12.5 percent and rock for 2.5 percent (Table 28).

The soil at the macroplot where this community was sampled is a member of a loamy-skeletal, mixed, mesic family of Lithic Mollic Haplargids (Appendix B-12).

Table 27. Species Density, Cover and Frequency for the *Juniperus osteosperma/Artemisia nova/Bromus tectorum* Community

Species	Density**	Cover %	20 x 20* Frequency %
Juniperus osteosperma	35.0	4.4	
Artemisia nova		18.6	76.5
Atriplex confertifolia			12.5
Artemisia spinescens			8.0
Bromus tectorum			45.5
Sitanion hystrix			19.5
Poa secunda			3.0

* Frame size in inches
** Trees/acre

Table 28. Ground Cover for the *Juniperus osteosperma/Artemisia nova/Bromus tectorum* Community

Material	Cover %
Bare ground	12.5
Litter	44.0
Pavement	13.0
Rock	2.5
Lichen	28.0

3. *Juniperus osteosperma/Chrysothamnus viscidiflorus/Agropyron smithii* Community

This community is located mostly in the southeast part of the watershed. It is found on northwest facing slopes of 18 to 30 percent, elevation is around 5400 feet. The mean annual precipitation is 11.9 inches (Appendix A).

Juniper *(Juniperus osteosperma)* occurs with 3.5 percent cover and a density of 10.0 trees per acre. Yellowbrush *(Chrysothamnus viscidiflorus)* is the dominant shrub with 5.6 percent cover and 35.0 percent frequency. Big sagebrush *(Artemisia tridentata)* is found with 0.8 percent cover and 12.5 percent frequency. Additional shrubs occur with 0.5 to 2.5 percent frequency.

Bluestem wheatgrass *(Agropyron smithii)*, Indian ricegrass *(Oryzopsis hymenoides)* and Great Basin wildrye *(Elymus cinereus)* occur with 18.5, 17.0 and 15.0 percent frequency, respectively. Squirreltail *(Sitanion hystrix)*, Sandberg bluegrass *(Poa secunda)*, cheatgrass *(Bromus tectorum)* and needle-and-thread grass *(Stipa comata)* are found with frequency of 1.5 to 9.0 percent.

Clasping pepperweed *(Lepidium perfoliatum)* is the most frequent forb (5.0 percent). Other forbs occur with 0.5 to 4.5 percent frequency (Table 29). This community is probably a seral representative of an *Artemisia tridentata/Oryzopsis hymenoides* habitat-type where juniper has invaded and yellowbrush has increased.

Bare ground accounts for 59.0 percent of the non-living ground cover, litter for 40.0 percent, pavement for 1.0 percent and rock for 0.0 percent (Table 30).

The soil at the macroplot where this community was sampled is a member of a sandy, mixed, frigid family of Typic Torripsamments (Appendix B-2).

Table 29. Species Density, Cover and Frequency for the *Juniperus osteosperma/Chrysothamnus viscidiflorus/ Agropyron smithii* Community

Species	Density**	Cover %	20 x 20* Frequency %
Juniperus osteosperma	10.0	3.5	
Chrysothamnus viscidiflorus		5.6	35.0
Artemisia tridentata		0.8	12.5
Tetradymia canescens			2.5
Chrysothamnus nauseosus			0.5
Agropyron smithii			18.5
Oryzopsis hymenoides			17.0
Elymus cinereus			15.0
Sitanion hystrix			9.0
Poa secunda			7.5
Bromus tectorum			3.0
Stipa comata			1.5
Lepidium perfoliatum			5.0
Cryptantha jamesii			4.5
Lygodesmia spinosa			0.5
Salsola kali var. *tenuifolia*			0.5

* Frame size in inches
** Trees/acre

Table 30. Non-living Ground Cover for the *Juniperus osteosperma/Chrysothamnus viscidiflorus/ Agropyron smithii* Community

Material	Cover %
Bare ground	59.0
Litter	40.0
Pavement	1.0
Rock	0.0

4. *Juniperus osteosperma/Chrysothamnus viscidiflorus/ Bromus tectorum* Community

This community occurs in the southern and central part of the watershed. It is found on slopes of all aspects with 5 to 22 percent slope, elevation ranges from 5700 to 6200 feet. The mean annual precipitation is 12.1 inches (Appendix A).

Juniper *(Juniperus osteosperma)* occurs with an average cover of 11.4 percent and a density of 26.0 trees per acre. Yellowbrush *(Chrysothamnus viscidiflorus)* and big sagebrush *(Artemisia tridentata)* are the most abundant shrubs with 6.3 and 3.8 percent cover and 12.6 and 10.7 percent frequency. Additional shrubs are found with 0.2 to 2.9 percent frequency and 20 to 60 percent constancy.

Cheatgrass *(Bromus tectorum)* and bluestem wheatgrass *(Agropyron smithii)* occur with 2.6 and 0.5 percent cover, and 40.7 and 24.8 percent frequency. Sandberg bluegrass *(Poa secunda)* and needle-and thread grass *(Stipa comata)* occur fairly frequently (23.6 and 19.0 percent, respectively). A variety of additional grasses are found in the community with varied frequency and constancy percents.

Phlox diffusa and clasping pepperweed *(Lepidium perfoliatum)* are the most frequent forbs (8.4 and 5.4 percent, respectively). There are a number of additional forbs that occur with 0.1 to 2.5 percent frequency and 20 to 40 percent constancy. This community is probably a seral representative of a *Juniperus osteosperma/Artemisia tridentata/ Oryzopsis hymenoides* habitat-type.

Litter accounts for 58.6 percent of the non-living ground cover, bare ground for 38.6 percent, pavement for 1.9 percent and rock for 0.9 percent (Table 32).

The soil at the macroplots where this community was sampled is a member of a loamy-skeletal, mixed, frigid family of Duric Mollic Camborthids (Appendix B-6); loamy-skeletal, mixed, frigid family of Mollic Camborthids (Appendix B-8); and a sandy, mixed, frigid, shallow family of Entic Haploxerolls (Appendix B-15).

Table 31. Species Density, Cover, Frequency and Constancy for the *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* Community

Species	Density**	Cover %	20 x 20* Frequency %	Constancy %
Juniperus osteosperma	26.0	11.4		100
Chrysothamnus viscidiflorus		6.3	12.6	100
Artemisia tridentata		3.8	10.7	100
Tetradymia canescens			2.9	60
Opuntia polyacantha			0.5	40
Eurotia lanata			0.2	20
Bromus tectorum		2.6	40.7	100
Agropyron smithii		0.5	24.8	100
Poa secunda			23.6	100
Stipa comata			19.0	80
Oryzopsis hymenoides			7.9	80
Sitanion hustrix			4.9	100
Stipa thurberiana			1.8	40
Elymus cinereus			0.8	60
Poa nevadensis			0.2	20
Agropyron cristatum			0.1	20
Phlox diffusa			8.4	80
Lepidium perfoliatum			5.4	80
Gayophytum ramosissimum			2.5	40
Lupinus caudatus			0.5	40
Cryptantha jamesii			0.4	60
Crepis acuminata			0.2	20
Agoseris glauca			0.1	20
Astragalus purshii			0.1	20
Eriogonum sp.			0.1	20
Eriogonum heermannii			0.1	20
Penstemon kingii			0.1	20

* Frame size in inches
** Trees/acre

Table 32. Non-living Ground Cover for the *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* Community

Material	Cover %
Bare ground	38.6
Litter	58.6
Pavement	1.9
Rock	0.9

DISCUSSION

Management Areas

Sheep grazing in most communities has been associated with a reduction of the more palatable forbs and shrubs and the invasion and increase of undesirable plants. The result has been an apparent elimination of many forbs, and in some communities the near elimination of big sagebrush. Yellowbrush has increased in almost every community and in some stands has become the dominant species, especially in old sheep bedding grounds and along old trails.

In an attempt to stop further deterioration of the basin and to improve watershed condition the grazing use has been changed from sheep to cattle; the Bureau of Land Management has regulated cattle numbers and season of grazing use; crested wheatgrass seedings have been put in; and some water developments have been made.

Range Rehabilitation and Improvement: There are several plant communities in the waterhsed that could be improved by chemical treatment. These are *Artemisia tridentata/Carex* sp./*Bromus tectorum*, *Artemisia tridentata/Chrysothamnus viscidiflorus/Elymus cinereus*, *Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda*, *Artemisia tridentata/Elymus cinereus/Bromus tectorum*, *Artemisia tridentata/Poa secunda/Elymus cinereus*, *Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus*, *Chrysothamnus viscidiflorus/Elymus cinereus* and *Chrysothamnus viscidiflorus/Poa secunda* communities. These communities occur mostly on slopes of 2 to 8 percent but may occur on slopes of 35 percent. The mean annual precipitation ranges from 11.4 to 12.5 inches. The more palatable native grasses that would be expected to respond to spraying are *Agropyron smithii*, *Elymus cinereus*, *Oryzopsis hymenoides*, *Agropyron spicatum* and *Stipa thurberiana*. These communities should be treated to control both *Artemisia tridentata* and *Chrysothamnus viscidiflorus*.

The communities in the watershed have a fairly high frequency of palatable native grasses, slopes are too steep and the soil is too sandy for recommending further mechanical treatments.

Management by Grazing: General improvement of the Crane Springs Watershed can be expected through a grazing management system such as rest-rotation or deferred-rotation. However, it is recommended that spraying accompany or proceed any grazing system, mainly to eradicate *Chrysothamnus viscidiflorus*.

Ecological Interpretations

The *Juniperus osteosperma* community is in near pristine condition, while all other communities are seral. These communities and associated soil families shown in Appendix C are discussed below.

The *Artemisia arbuscula/Poa secunda* community has developed in the southeast part of the watershed as small inclusions on north facing slopes of 6 percent. It is found on soils with a 2-inch ochric epipedon over a strong medium prismatic, clay argillic horizon. This community is probably a seral representative of an *Artemisia arbuscula/Stipa webberi* habitat-type.

On south facing slopes of 10 to 25 percent in the northern end of the watershed the *Artemisia nova/Bromus tectorum* community is located. It occurs on soils with a 4-inch ochric epipedon over a moderate medium subangular blocky, gravelly clay loam argillic horizon and lithic contact within 10 inches of the soil surface. This community is probably a seral representative of an *Artemisia nova/Oryzopsis hymenoides* habitat-type.

The *Atriplex confertifolia/Bromus tectorum* community occurs in the northern part of the watershed on all aspects with 2 to 37 percent slope. It is found on soils with a 4-inch ochric epipedon over a weak fine subangular blocky, gravelly clay loam cambic horizon and a calcic horizon within 26 inches of the soil surface; a 4-inch ochric epipedon over a weak fine subangular blocky, sandy loam cambic horizon and a calcic horizon within 8 inches of the surface. This community is a seral representative of an *Atriplex confertifolia/Artemisia spinescens/Oryzopsis hymenoides* habitat-type.

The *Artemisia tridentata/Elymus cinereus* habitat-type is represented by the following seral communities: *Artemisia tridentata/Bromus tectorum, Artemisia tridentata/Chrysothamnus viscidiflorus/Elymus cinereus, Artemisia tridentata/Elymus cinereus/Bromus tectorum, Artemisia tridentata/Poa secunda/Elymus cinereus, Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus,* and *Chrysothamnus viscidiflorus/Elymus cinereus*. These communities occur on fans, terraces and drainage bottoms of all aspects with 1 to 7 percent slope. The soils are characterized by a 2- to 8-inch ochric epipedon over a massive, loamy sand C1 horizon and may or may not have a few durinodes within 21 inches of the surface; a 14-inch ochric epipedon over a weak coarse platy, very fine sandy loam C1 horizon; a 3- to 4-inch ochric epipedon over a massive, sandy clay cambic horizon and durinodes within 14 to 17 inches of the surface; a 12-inch ochric epipedon over a massive, fine sandy loam cambic horizon; a 3-inch ochric epipedon over a massive, sandy clay loam cambic horizon and a weakly cemented duripan within 29 inches of the soil surface; and an 8-inch ochric epipedon over a moderate medium prismatic, clay loam argillic horizon.

The *Artemisia tridentata/Carex* sp./*Bromus tectorum* community is located in the southwest part of the watershed on east facing slopes of 8 percent. It occurs on soils with a 10-inch mollic epipedon over and in conjunction with a strong medium prismatic, heavy clay argillic horizon. This community is probably a seral representative of an *Artemisia tridentata/Agropyron smithii/Carex* sp. habitat-type.

The *Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda* community has developed in the southern part of the watershed on west, southeast and east facing slopes and drainage bottoms with 2 to 7 percent slope. It occurs on soils with a 2- to 8-inch ochric epipedon over a massive, loamy sand C1 horizon and may or may not have a few durinodes within 21 inches of the surface, and a 3- to 4-inch ochric epipedon over a massive, sandy clay loam cambic horizon and durinodes within 14 to 17 inches of the surface. This community is probably a seral representative of an *Artemisia tridentata/Elymus cinereus/ Agropyron smithii* habitat-type.

In the southwest part of the watershed on west facing slopes of 35 percent the *Chrysothamnus viscidiflorus/Poa secunda* community is found. It occurs on soils with a 10-inch mollic epipedon over and in conjunction with a strong medium prismatic, heavy clay argillic horizon. This community is probably a seral representative of an *Artemisia tridentata/Agropyron spicatum* habitat-type.

The *Juniperus osteosperma* community occurs on slopes of all aspects with 12 to 45 percent slope in the central part of the watershed. It occurs on soils with a 3-inch ochric epipedon over a single grain, very gravelly very fine loamy sand C1 horizon and paralithic contact within 17 inches of the surface. This community is a representative of a *Juniperus osteosperma* habitat-type.

The *Juniperus osteosperma/Artemisia nova/Bromus tectorum* community is found in the north part of the watershed on south facing slopes of 10 to 25 percent. It occurs on soils with a 4-inch ochric epipedon over a moderate medium subangular blocky, gravelly clay loam argillic horizon and lithic contact within 10 inches of the surface. This community is probably a seral representative of a *Juniperus osteosperma/Artemisia nova/Oryzopsis hymenoides* habitat-type.

The *Juniperus osteosperma/Chrysothamnus viscidiflorus/Agropyron smithii* community is located mostly in the southeast part of the watershed on northeast facing slopes of 18 to 30 percent. It occurs on soils with a 2- to 8-inch ochric epipedon over a massive, loamy sand C1 horizon and may or may not have a few durinodes within 21 inches of the surface. This community is probably a seral representative of an *Artemisia tridentata/Oryzopsis hymenoides* habitat-type where juniper has invaded and yellowbrush has increased.

The *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* community has developed in the southern and central part of the watershed on slopes of all aspects with 5 to 22 percent slope. It occurs on soils with a 4-inch ochric epipedon over a weak medium subangular blocky, very gravelly sandy clay loam cambic horizon and a

weakly cemented duripan within 18 inches of the surface; a weak medium subangular blocky, very gravelly sandy clay loam cambic horizon; and an 8-inch mollic epipedon over a massive, loamy sand C1 horizon, and paralithic contact within 16 inches of the soil surface. This community is probably a seral representative of a *Juniperus osteosperma/Artemisia tridentata/Oryzopsis hymenoides* habitat-type.

Climaxes:

Climax as used in this report is defined as the kind of community capable of perpetuation under the prevailing climatic, edaphic, physiographic or biotic condition. This definition is in accordance with the polyclimax concept where several climaxes constitute the vegetation in an area as the result of succession.

Climatic climax developes on land (moderately rolling to level) that is neither excessively or inadequately drained, so that the major environmental conditions affecting organisms are climatic. Physiographic climax is determined in large measure by the nature of the topography (land relief). Edaphic climax is determined largely by the nature of the soil. A physiographic-edaphic climax is determined mostly by both topography and soils. A biotic climax is determined by the incidence and maintenance of a decisive "biotic factor" such as the continuous heavy grazing by animals (Hanson, 1962).

Most all of the communities in the watershed have been affected by grazing use and areas of relatively undisturbed vegetation are not common. Consequently, a majority of the communities are biotic climaxes. For this reason an estimate of the climax of each community is based on their present condition and probable habitat-type (Table 33).

RECREATION

The watershed is located fairly close to Elko, however, it has very little value for recreational development. This is especially true when compared to other areas around Elko.

Table 33. Type of climaxes associated with the probable habitat-types and present communities in the Crane Springs Communities.

Probable Habitat-type and Present Communities	Type of Climax				
	Climatic	Physio-graphic	Edaphic	Physio-graphic Edaphic	Biotic
A.[a] *Artemisia arbuscula/Oryzopsis webberi*				X	
1.[b] *A. arbuscula/Poa secunda*					X
B.[a] *Artemisia nova/Oryzopsis hymenoides*				X	
1[b] *A. nova/Bromus tectorum*					X
C.[a] *Artemisia tridentata/Agropyron smithii/Carex* sp.				X	
1[b] *A. tridentata/Carex* sp./*Bromus tectorum*					X
D.[a] *Artemisia tridentata/Agropyron spicatum*	X			X	
1[b] *Chrysothamnus viscidiflorus/Poa secunda*					X
E.[a] *Artemisia tridentata/Elymus cinereus*			X		
1[b] *A. tridentata/Bromus tectorum*					X
2[b] *A. tridentata/C. viscidiflorus/Elymus cinereus*					X
3[b] *A. tridentata/Elymus cinereus/Bromus tectorum*					X
4[b] *A. tridentata/Poa secunda/Elymus cinereus*					X
5[b] *C. viscidiflorus/Agropyron smithii/Elymus cinereus*					X
6[b] *C. viscidiflorus/Elymus cinereus*					X
F.[a] *Artemisia tridentata/E. cinereus/A. smithii*				X	
1[b] *A. tridentata/C. viscidiflorus/Poa secunda*					X
G.[a] *Artemisia tridentata/Oryzopsis hymenoides*				X	
1[b] *Juniperus osteosperma/C. viscidiflorus/A. smithii*					X
H.[a] *Atriplex confertifolia/Oryzopsis hymenoides*				X	
1[b] *A. confertifolia/Artemisia spinescens/B. tectorum*					X
I.[ab] *Juniperus osteosperma*				X	
J.[a] *J. osteosperma/Artemisia nova/Bromus tectorum*				X	
K.[a] *J. osteosperma/A. tridentata/Oryzopsis hymenoides*				X	
1[b] *J. osteosperma/C. viscidiflorus/B. tectorum*					X

a. Habitat-type b. Present Community ab. Habitat-type and Present Community

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APPENDIX A. Precipitation Data for the Crane Springs Watershed.

Rain can	Annual Precipitation (Inches)	Rain can	Annual* Precipitation (Inches)
1	11.4	7	13.1
2	11.3	8	12.4
3	11.3	9	12.1
4	12.0	10	12.7
5	11.4	11	11.0
6	12.4	Mean	12.0

* Annual precipitation is based on 4 consecutive hydrologic years (October 1 to September 30), 1965 through 1968.

Community	Annual * Precipitation (Inches)
Artemisia arbuscula/Poa secunda	12.7
Artemisia nova/Bromus tectorum	11.4
Artemisia tridentata/Bromus tectorum	11.4
Artemisia tridentata/Carex sp./*Bromus tectorum*	11.3
A. tridentata/Chrysothamnus viscidiflorus/Elymus cinereus	12.5
A. tridentata/C. viscidiflorus/Poa secunda	12.0
A. tridentata/Elymus cinereus/Bromus tectorum	11.8
A. tridentata/Poa secunda/Elymus cinereus	11.4
Atriplex confertifolia/Bromus tectorum	12.0
C. viscidiflorus/Agropyron smithii/Elymus cinereus	12.2
C. viscidiflorus/Elymus cinereus	12.0
C. viscidiflorus/Poa secunda	12.1
Juniperus osteosperma	12.3
J. osteosperma/Artemisia nova/Bromus tectorum	11.4
J. osteosperma/C. viscidiflorus/Agropyron smithii	11.9
J. osteosperma/C. viscidiflorus/Bromus tectorum	12.1

* Annual precipitation is based on rain cans in or near each community and on 4 consecutive hydrologic years (October 1 to September 30), 1965 through 1968.

APPENDIX B - Soil Families and Sub-groups Associated with the Crane Springs Watershed Plant Communities.

APPENDIX B-1

Sandy-skeletal, mixed, frigid, shallow family of Typic Torripsamments

Characteristically these soils have a 3-inch ochric epipedon over a single grain, very gravelly very fine loamy sand C1 horizon and paralithic contact within 17 inches of the surface. Reaction of the surface horizon is moderately alkaline.

These soils are usually found at elevations from 5480 to 5550 feet and are associated with the *Juniperus osteosperma* community. They are found on west facing slopes with 20 to 45 percent. The macrorelief is hilly and the microrelief is uniform convex or uniform concave. These soils belong to the C hydrologic group and have a profile available water holding capacity of 1.3 inches. Stoniness class is 1. The majority of the roots are found within 3 to 11 inches of the soil surface. There is moderate to advanced sheet and gully erosion.

A 1	0-3"	Light gray (2.5Y7/2) gravelly loamy sand, grayish brown (2.5Y5/2) moist; single grain; loose, loose, nonsticky, nonplastic; plentiful very fine and plentiful fine roots; organic matter 1.9 percent, conductivity 0.3 mmhos., cation exchange capacity 12.0 meq.; violently effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
C 1	3-11"	Light olive brown (2.5Y5/4) moist; very gravelly very fine loamy sand; single grain; loose, loose, nonsticky, nonplastic; abundant very fine, abundant fine, abundant medium and plentiful coarse roots; violently effervescent; clear smooth boundary.
C 2	11-17"	Light olive brown (2.5Y5/4) moist; very gravelly very fine loamy sand; single grain; loose, loose, nonsticky, nonplastic; plentiful very fine, plentiful fine roots; violently effervescent; abrupt irregular boundary.
R1	17-27"+	Paralithic contact with weathered sandstone.

APPENDIX B-2

Sandy, mixed, frigid family of Typic Torripsamments

These soils typically have a 2- to 8-inch ochric epipedon over a massive, loamy sand C1 horizon and may or may not have a few durinodes within 21 inches of the surface. Reaction of the surface horizon is neutral.

These soils are usually found at elevations from 5200 to 6800 feet and are associated with the *Artemisia tridentata/Bromus tectorum, Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda, Chrysothamnus viscidiflorus/Elymus cinereus,* and *Juniperus osteosperma/Chrysothamnus viscidiflorus/Agropyron smithii* communities. They are found on north, southwest, and west facing slopes and fans with 2 to 37 percent slope. The macrorelief is rolling or hilly and the microrelief is uniform convex or uniform concave. These soils belong to the B hydrologic group and have a profile available water holding capacity of 2.2 to 3.2 inches. Stoniness class is 0. The majority of the roots are found within 18 inches of the soil surface. There is slight to no sheet and rill erosion with some advanced gully erosion in localized areas.

A 11	0-3"	Pale brown (10YR6/3) loamy sand, dark yellowish brown (10YR4/4) moist; moderate medium platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 0.5 percent, conductivity 0.1 mmhos., cation exchange capacity 7.1 meq.; noneffervescent; neutral (pH 7.3); vesicular pores; abrupt smooth boundary.
A 12	3-8"	Pale brown (10YR6/3) loamy sand, dark yellowish brown (10YR4/4) moist; weak medium platy; soft, very friable nonsticky, nonplastic; few very fine and few fine roots; noneffervescent; clear smooth boundary.
C 1	8-21"	Light yellowish brown (10YR6/4) loamy sand, dark yellowish brown (10YR4/4) moist; massive; soft, very friable, nonsticky, nonplastic; abundant very fine, abundant fine, few medium and few coarse roots; non-effervescent; clear smooth boundary.
C 2	21-32"	Light yellowish brown (10YR6/4) loamy sand, dark yellowish brown (10YR4/4) moist; massive; soft, very friable, nonsticky, nonplastic; few very fine and few fine roots; strongly effervescent; few durinodes may be present.

APPENDIX B-3

Coarse-loamy, mixed, frigid family of Typic Torriorthents

These soils characteristically have a 14-inch ochric epipedon over a weak coarse platy, very fine sandy loam C1 horizon. Reaction of the surface horizon is moderately alkaline.

These soils are usually found at elevations around 5300 feet and are associated with the *Artemisia tridentata/Bromus tectorum* community. They are found on northwest facing fans with 1 percent slope. The macrorelief is flat and the microrelief is uniform flat. These soils belong to the B hydrologic group and have a profile available water holding capacity of 3.2 inches. Stoniness class is 0. The majority of the roots are found within 25 inches of the soil surface. There is slight to no sheet and rill erosion, with slight to moderate gully erosion.

A 11	0-4"	Pale brown (10YR6/3) sandy loam, brown (10YR4/3) moist; weak medium platy; soft, friable, nonsticky, nonplastic; few fine roots; organic matter 0.7 percent, conductivity 0.2 mmhos., cation exchange capacity 8.9 meq.; noneffervescent; vesicular pores; moderately alkaline (pH 8.1); abrupt smooth boundary.
A 12	4-8"	Pale brown (10YR6/3) sandy loam, yellowish brown (10YR5/4) moist; moderate medium platy; slightly hard, friable, nonsticky, nonplastic; plentiful very fine and plentiful fine roots; slightly effervescent; abrupt smooth boundary.
A 13	8-14"	Pale brown (10YR6/3) sandy loam, yellowish brown (10YR5/4) moist; massive; soft, very friable, nonsticky, nonplastic; plentiful very fine and plentiful fine roots; strongly effervescent; clear smooth boundary.
C 1	14-37"	Pale brown (10YR6/3) very fine sandy loam, yellowish brown (10YR5/4) moist; weak coarse platy; slightly hard, friable, nonsticky, nonplastic; plentiful very fine, plentiful fine and plentiful medium roots; strongly effervescent; abrupt smooth boundary.
IIC2	37-40"+	Light gray (10YR7/2) loamy sand, yellowish brown (10YR5/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; few fine and few coarse roots; strongly effervescent.

APPENDIX B-4

Loamy-skeletal, mixed, mesic family of Mollic Calciorthids

These soils characteristically have a 4-inch ochric epipedon over a weak fine subangular blocky, gravelly clay loam cambic horizon and a calcic horizon within 26 inches of the soil surface. Reaction of the surface horizon is mildly alkaline.

These soils are usually found at elevations around 5350 feet and are associated with the *Atriplex confertifolia/Bromus tectorum* community. They occur on southwest facing slopes of 37 percent. The macrorelief is hilly and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 3.9 inches. Stoniness class is 2. The majority of the roots are found within 20 inches of the soil surface. There is slight sheet and rill erosion with some small gullies formed.

A 1	0-4"	Light gray (10YR7/1) gravelly loam, brown (10YR4/3) moist; weak fine platy; very friable, slightly sticky, slightly plastic; few fine roots; organic matter 1.1 percent, conductivity 0.2 mmhos., cation exchange capacity 12.1 meq.; violently effervescent; mildly alkaline (pH 7.8); vesicular pores; abrupt smooth boundary.
B 2	4-14"	Pale brown (10YR6/3) gravelly clay loam, brown (10YR5/3) moist; weak fine subangular blocky; slightly hard, friable, sticky, plastic; few very fine, plentiful fine and few medium roots; organic matter 1.2 percent, conductivity 0.6 mmhos.; violently effervescent; mildly alkaline (pH 7.7); clear smooth boundary.
C 1	14-26"	Light gray (10YR7/2) very gravelly clay loam, pale brown (10YR6/3) moist; massive; slightly hard, friable, sticky, plastic; plentiful very fine, plentiful fine and few medium roots; violently effervescent; abrupt smooth boundary.
C2ca	26-33"+	White (10YR8/2) very gravelly loam, light yellowish brown (10YR6/4) moist; massive; slightly hard, firm, slightly sticky, slightly plastic; few very fine and few fine roots; slightly effervescent.

APPENDIX B-5

Coarse-loamy, mixed, mesic family of Mollic Calciorthids

Typically these soils have a 4-inch ochric epipedon over a weak fine subangular blocky, sandy loam cambic horizon and a calcic horizon within 8 inches of the surface. Reaction of the surface horizon is mildly alkaline.

These soils are usually found at elevations around 5365 feet and are associated with the *Atriplex confertifolia/Bromus tectorum* community. They are found on southwest facing fans with 2 percent slope. The macrorelief is undulating and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 2.7 inches. Stoniness class is 1. The majority of the roots are found within 14 inches of the soil surface. There is slight to no erosion.

A 1	0-4"	Very pale brown (10YR7/3) gravelly sandy loam, yellowish brown (10YR5/4) moist; weak medium platy; slightly hard, friable, nonsticky, nonplastic; plentiful very fine and few fine roots; organic matter 1.7 percent, conductivity 0.3 mmhos., cation exchange capacity 8.5 meq.; violently effervescent; mildly alkaline (pH 7.8); vesicular pores; abrupt smooth boundary.
B 2	4-8"	Light yellowish brown (10YR6/4) moist; sandy loam; weak fine subangular blocky; slightly hard, friable, nonsticky, nonplastic; plentiful very fine, plentiful fine, and few medium roots; organic matter 1.5 percent, conductivity 0.7 mmhos.; violently effervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.
C1ca	8-16"	White (10YR8/2) gravelly sandy loam, very pale brown (10YR7/3) moist; massive; slightly hard, friable, nonsticky, nonplastic; few very fine, few fine and few medium roots; violently effervescent; clear smooth boundary.
C2ca	16-30"+	Very pale brown (10YR8/3) gravelly sandy loam, very pale brown (10YR7/4) moist; massive; hard, friable, nonsticky, nonplastic; few fine and few medium roots; violently effervescent.

APPENDIX B-6

Loamy-skeletal, mixed, frigid family of Duric Mollic Camborthids

These soils characteristically have a 4-inch ochric epipedon over a weak medium subangular blocky, very gravelly sandy clay loam cambic horizon and a weakly cemented duripan within 18 inches of the surface. Reaction of the solum is neutral.

These soils are usually found at elevations around 5800 feet and are associated with the *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* community. They are found on northwest facing slopes of 8 to 22 percent. Macrorelief is undulating or hilly and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 2.1 inches. Stoniness class is 2. The majority of the roots are found within 18 inches of the soil surface. There is slight to no erosion.

A 1	0-4"	Light brownish gray (10YR6/2) gravelly fine sandy loam, dark grayish brown (10YR4/2) moist; moderate fine granular; slightly hard, friable, nonsticky, nonplastic; few very fine roots; organic matter 1.2 percent, conductivity 0.2 mmhos., cation exchange capacity 9.1 mmhos.; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.
B 2	4-12"	Very pale brown (10YR7/3) very gravelly sandy loam, yellowish brown (10YR5/4) moist; weak medium subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; abundant very fine, abundant fine and plentiful medium roots; organic matter 1.2 percent, conductivity 0.1 mmhos., noneffervescent; neutral (pH 7.0); clear smooth boundary.
C 1	12-18"	Very pale brown (10YR7/3) gravelly sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; plentiful very fine, plentiful fine and plentiful medium roots; strongly effervescent; abrupt smooth boundary.
C 2	18-24"+	Light gray (10YR7/2) loamy sand, yellowish brown (10YR5/4) moist; massive; soft, very friable, nonsticky, nonplastic; few fine roots; violently effervescent; very weakly cemented duripan.

APPENDIX B-7

Coarse-loamy, mixed, frigid family of Duric Mollic Camborthids

Characteristically these soils have a 3- to 4-inch ochric epipedon over a massive, sandy clay loam cambic horizon and durinodes within 14 to 17 inches of the surface. Reaction of the solum increases with depth and ranges from mildly alkaline to moderate alkaline.

These soils are found at elevations that range from 5400 to 6000 feet and are associated with the *Artemisia tridentata/Bromus tectorum*, *Artemisia tridentata/Chrysothamnus viscidiflorus/Elymus cinereus*, *Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda*, *Artemisia tridentata/Elymus cinereus/Bromus tectorum* and *Chrysothamnus viscidiflorus/Agropyron smithii/Elymus cinereus* communities. They are found on west, southwest, northwest and north facing drainage bottoms and fans with 2 to 4 percent slope. The macrorelief is undulating and the microrelief is uniform convex or uniform flat. These soils belong to the B hydrologic group and have a profile available water holding capacity of 3.4 to 3.8 inches. Stoniness class is 0. The majority of the roots are found within 28 inches of the soil surface. There is slight to no gully and sheet erosion.

A 11	0-1"	Light gray (10YR7/2) sandy loam, dark yellowish brown (10YR3/3) moist; moderate fine platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 1.6 percent, conductivity 0.2 mmhos., cation exchange capacity 11.0 meq.; strongly effervescent; mildly alkaline (pH 7.7); vesicular pores; abrupt smooth boundary.
A 12	1-3"	Light brownish gray (10YR6/3) sandy loam, brown (10YR4/3) moist; moderate medium platy; soft, very friable, nonsticky, nonplastic; plentiful very fine and few fine roots; strongly effervescent; clear smooth boundary.
B 2	3-17"	Very pale brown (10YR7/3) sandy clay loam, yellowish brown (10YR5/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; abundant very fine, abundant fine and plentiful medium roots; organic matter 1.3 percent, conductivity 0.2 mmhos.; violently effervescent; moderately alkaline (pH 8.1); gradual smooth boundary.
C 1	17-38"+	Very pale brown (10YR7/3) very fine sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; plentiful very fine, plentiful fine and plentiful medium roots; violently effervescent; few durinodes present.

APPENDIX B-8

Loamy-skeletal, mixed, frigid family of Mollic Camborthids

These soils typically have a 3-inch ochric epipedon over a weak medium subangular blocky, very gravelly sandy clay loam cambic horizon. Reaction of the solum is neutral.

These soils are usually found at elevations around 5800 feet and are associated with the *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* community. They are found on northwest facing slopes of 8 percent. The macrorelief is undulating and the microrelief is uniform convex. These soils belong to the B hydrologic group and have a profile available water holding capacity of 2.4 inches. Stoniness class is 2. The majority of the roots are found within 13 inches of the soil surface. There is slight to no erosion.

A 1	0-3"	Pale brown (10YR6/3) gravelly fine sandy loam, dark yellowish brown (10YR3/4) moist; strong fine platy; slightly hard, friable, nonsticky, nonplastic; few very fine roots; organic matter 1.2 percent, conductivity 0.2 mmhos., cation exchange capacity 10.1 meq.; noneffervescent; neutral (pH 6.8); vesicular pores; abrupt smooth boundary.
B 2	3-10"	Pale brown (10YR6/3) very gravelly sandy clay loam, brown (10YR4/3) moist; weak medium subangular blocky; slightly hard, friable, slightly sticky, nonplastic; abundant very fine, abundant fine and plentiful medium roots; organic matter 1.0 percent, conductivity 0.1 mmhos.; noneffervescent; neutral (pH 7.1); clear smooth boundary.
C 1	10-13"	Very pale brown (10YR7/3) gravelly sandy loam, dark yellowish brown (10YR4/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; plentiful very fine and plentiful fine roots; strongly effervescent; clear smooth boundary.
C 2	13-29"+	Very pale brown (10YR7/3) loamy sand, yellowish brown (10YR5/4) moist; massive; soft, very friable, nonsticky, nonplastic; violently effervescent; few fine roots.

APPENDIX B-9

Coarse-loamy, mixed, mesic family of Mollic Camborthids

These soils characteristically have a 5-inch ochric epipedon over a massive, gravelly sandy loam cambic horizon. Reaction of the solum decreases with depth and ranges from moderately alkaline to mildly alkaline,

These soils are usually found at elevations around 5400 feet and are associated with the *Artemisia tridentata/Bromus tectorum* community. They are found on southwest facing fans with 23 percent slope. Macrorelief is rolling and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 3.4 inches. Stoniness class is 2. The majority of the roots are found within 18 inches of the soil surface. There is slight to no erosion.

A 1	0-5"	Light brownish gray (10YR6/2) gravelly sandy loam, brown (10YR4/3) moist; strong fine platy; slightly hard, very friable, nonsticky, nonplastic; few fine roots; organic matter 1.5 percent, conductivity 1.0 mmhos., cation exchange capacity 7.5 meq.; strongly effervescent; moderately alkaline (pH 8.0); vesicular pores; abrupt smooth boundary.
B 2	5-14"	Yellowish brown (10YR5/4) moist; gravelly sandy loam; massive; hard, friable, slightly sticky, nonplastic; few very fine and plentiful fine roots; organic matter 1.2 percent, conductivity 0.3 mmhos.; violently effervescent; mildly alkaline (pH 7.6); clear smooth boundary.
C 1	14-38"	Dark yellowish brown (10YR4/4) moist; gravelly sandy loam; massive; soft, very friable, nonsticky, nonplastic; few very fine and plentiful fine roots; violently effervescent; lime accumulation on rocks and gravel.

APPENDIX B-10

Coarse-loamy, mixed, frigid family of Mollic Camborthids

Typically these soils have a 12-inch ochric epipedon over a massive, fine sandy loam cambic horizon. Reaction of the solum is neutral.

These soils are usually found at elevations from 5300 to 5400 feet and are associated with the *Artemisia tridentata/Bromus tectorum* and *Artemisia tridentata/Elymus cinereus/Bromus tectorum* communities. They are found on north, west and southwest facing terraces and fans with 1 to 2 percent slope. Macrorelief is flat and the microrelief is uniform flat. These soils belong to the B hydrologic group and have a profile available water holding capacity of 4.0 inches. Stoniness class is 0. The majority of the roots are found within 15 inches of the soil surface. There is slight to moderate gully erosion.

A 1	0-8"	Light brownish gray (10YR6/2) very fine sandy loam, dark grayish brown (10YR4/2) moist; strong fine to strong medium platy; soft, friable, nonsticky, nonplastic; abundant very fine, abundant fine and few medium roots; organic matter 0.9 percent, conductivity 0.2 mmhos., cation exchange capacity 9.4 meq.; noneffervescent; neutral (pH 7.3); vesicular pores; abrupt smooth boundary.
A 12	8-12"	Light brownish gray (10YR6/2) fine sandy loam, brown (10YR4/3) moist; weak coarse platy; slightly hard, friable, nonsticky, nonplastic; abundant very fine, abundant fine and plentiful medium roots; noneffervescent; clear smooth boundary.
B 2	12-37"	Pale brown (10YR6/3) fine sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; few very fine, few fine, few medium and few coarse roots; organic matter 0.8 percent, conductivity 3.0 mmhos.; strongly effervescent; neutral (pH 7.3); gradual smooth boundary.
C 1	37-40"	Pale brown (10YR6/3) fine sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; few fine and few coarse roots; violently effervescent; lime concentration on gravel.

APPENDIX B-11

Coarse-loamy, mixed, frigid family of Entic Mollic Durorthids

Characteristically these soils have a 3-inch ochric epipedon over a massive, sandy clay loam cambic horizon and a weakly cemented duripan within 29 inches of the soil surface. Reaction of the solum is moderately alkaline.

These soils are usually found at elevations around 5700 feet and are associated with the *Artemisia tridentata/Poa secunda/Elymus cinereus* community. They are found on north facing drainage bottoms of 2 percent slope. The macrorelief is undulating and the microrelief is uniform flat. These soils belong to the C hydrologic group and have a profile available water holding capacity of 2.9 inches. Stoniness class is 0. The majority of the roots are found within 19 inches of the soil surface. There is slight rill and gully erosion.

A 1	0-3"	Light brownish gray (10YR6/2) sandy loam, brown (10YR4/3) moist; moderate medium platy; soft, very friable, nonsticky, nonplastic; plentiful very fine and few fine roots; organic matter 0.4 percent, conductivity 0.2 mmhos., cation exchange capacity 10.1 meq.; strongly effervescent; moderately alkaline (pH 8.0); vesicular pores upper 1-inch; clear smooth boundary.
B 2	3-17"	Very pale brown (10YR7/3) sandy clay loam, yellowish brown (10YR5/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; abundant very fine, abundant fine and plentiful medium roots; organic matter 0.3 percent, conductivity 0.2 mmhos.; violently effervescent; gradual smooth boundary.
C 1	17-29"	Very pale brown (10YR7/3) very fine sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; abundant very fine, abundant fine and plentiful medium roots; violently effervescent.
Clcasiam	29"+	Weakly cemented duripan.

APPENDIX B-12

Loamy-skeletal, mixed, mesic family of Lithic Mollic Haplargids

These soils typically have a 4-inch ochric epipedon over a moderate medium subangular blocky, gravelly clay loam argillic horizon and lithic contact within 10 inches of the surface. Reaction of the solum is mildly alkaline.

These soils are usually found at elevations from 5400 to 5650 feet and are associated with the *Artemisia nova/Bromus tectorum* and *Juniperus osteosperma/Artemisia nova/Bromus tectorum* communities. They are found on south facing slopes of 10 to 25 percent. The macrorelief is mountainous and the microrelief is uniform convex. These soils belong to the D hydrologic group and have a profile available water holding capacity of 1.4 inches. Stoniness class is 2. The majority of the roots are found within 10 inches of the soil surface. There is slight to no sheet and rill erosion.

A 1	0-4"	Light gray (10YR7/2) gravelly loam, brown (10YR4/3) moist; strong fine platy; slightly hard, friable, slightly sticky, slightly plastic; organic matter 2.3 percent, conductivity 0.4 mmhos., cation exchange capacity 12.4 meq.; violently effervescent; mildly alkaline (pH 7.6); vesicular pores; abrupt smooth boundary.
B 2	4-10"	Very pale brown (10YR7/3) gravelly clay loam, dark brown (7.5YR4/4) moist; moderate medium subangular blocky; slightly hard, friable, sticky, plastic; plentiful very fine and plentiful fine roots; organic matter 1.6 percent, conductivity 0.8 mmhos.; violently effervescent; mildly alkaline (pH 7.4); abrupt irregular boundary.
R 1	10"+	Lithic contact with dolomite.

APPENDIX B-13

Fine-loamy, mixed, frigid family of Duric Mollic Haplargids

Characteristically these soils have an 8-inch ochric epipedon over a moderate medium prismatic, clay loam argillic horizon. Reaction of the solum is mildly alkaline.

These soils are usually found at elevations around 5400 feet and are associated with the *Artemisia tridentata/Bromus tectorum* community. They are found on north facing fans with 1 percent slope. The macrorelief is rolling and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 3.3 inches. Stoniness class is 0. The majority of the roots are found within 18 inches of the soil surface. There is slight to no erosion.

A 11	0-4"	Light yellowish brown (10YR6/4) sandy loam, dark yellowish brown (10YR4/4) moist; strong medium platy; slightly hard, friable, nonsticky, nonplastic; few very fine and few fine roots; organic matter 1.0 percent, conductivity 0.1 mmhos., cation exchange capacity 11.6 meq.; noneffervescent; mildly alkaline (pH 7.6) vesicular pores; abrupt smooth boundary.
A 12	4-8"	Pale brown (10YR6/3) sandy loam, brown (10YR4/3) moist; moderate medium granular; soft, friable, nonsticky, nonplastic; few very fine and few fine roots; noneffervescent; abrupt smooth boundary.
B2t	8-14"	Dark brown (7.5YR4/4) moist; clay loam; moderate medium prismatic breaking to moderate medium subangular blocky; slightly hard, friable, sticky, plastic; plentiful very fine, abundant fine and plentiful medium roots; organic matter 0.8 percent, conductivity 0.2 mmhos.; slightly effervescent; mildly alkaline (pH 7.5); clear smooth boundary.
B3ca	14-24"	Very pale brown (10YR7/3) sandy loam, pale brown (10YR6/3) moist; massive; hard, firm, nonsticky, nonplastic; few very fine, plentiful fine and few medium roots; violently effervescent; clear smooth boundary; durinodes.
C 1	24-30"	Very pale brown (10YR7/3) sandy loam, brown (10YR5/3) moist; massive; soft, friable, nonsticky, nonplastic; few fine roots; violently effervescent.

APPENDIX B-14

Very fine, montmorillonitic, frigid family of Mollic Paleargids

Characteristically these soils have a 2-inch ochric epipedon over a strong medium prismatic, clay argillic horizon. Reaction of the solum decreases with depth and ranges from neutral to slightly acid.

These soils are usually found at elevations around 6300 feet and are associated with the *Artemisia arbuscula/Poa secunda* community. They are found on north facing slopes of 6 percent. The macrorelief is hilly and the microrelief is convex. These soils belong to the D hydrologic group and have a profile available water holding capacity of 4.4 inches. Stoniness class is 2. The majority of the roots are found within 16 inches of the soil surface. There is no erosion.

A 1	0-2"	Grayish brown (10YR5/2) fine sandy loam, very dark grayish brown (10YR3/2) moist; strong fine platy; slightly hard, friable, nonsticky,nonplastic; abundant very fine, abundant fine roots; organic matter 1.8 percent, conductivity 0.2 mmhos., cation exchange capacity 14.0 meq.; noneffervescent; neutral (pH 7.0); vesicular pores; abrupt smooth boundary.
B2t	2-17"	Dark brown (10YR3/3) moist; clay; strong medium prismatic; extremely hard, extremely firm, very sticky, very plastic; few very fine, few fine, few medium and few coarse roots; organic matter 1.3 percent, conductivity 0.3 mmhos.; noneffervescent; slightly acid (pH 6.5); pressure faces; clear smooth boundary.
B 3	17-23"	Dark yellowish brown (10YR4/4) moist; heavy clay loam; massive; hard, firm, sticky, plastic; few very fine roots; strongly effervescent; clear smooth boundary.
C 1	23-26"+	Dark yellowish brown (10YR4/4) moist; light clay loam; massive; slightly hard, friable, sticky, plastic; strongly effervescent.

APPENDIX B-15

Sandy, mixed, frigid, shallow family of Entic Haploxerolls

Typically these soils have a 8-inch mollic epipedon over a massive, loamy sand C1 horizon and paralithic contact within 16 inches of the soil surface. Reaction of the surface horizon is neutral.

These soils are usually found at elevations around 5900 feet and are associated with the *Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum* community. They are found on east facing slopes of 5 percent. The macrorelief is hilly and the microrelief is uniform convex. These soils belong to the C hydrologic group and have a profile available water holding capacity of 1.6 inches. Stoniness class is 0. The majority of the roots are found within 16 inches of the soil surface. There is slight to no sheet erosion.

A 1	0-3"	Grayish brown (10YR5/2) loamy sand, very dark grayish brown (10YR3/2) moist; single grain; loose, loose, nonsticky, nonplastic; few very fine and few fine roots; organic matter 0.9 percent, conductivity 0.2 mmhos., cation exchange capacity 6.8 meq.; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.
A 12	3-8"	Grayish brown (10YR5/2) loamy sand, very dark grayish brown (10YR3/2) moist; weak medium platy; soft, very friable, nonsticky, nonplastic; plentiful very fine, plentiful fine and plentiful medium roots; noneffervescent; clear smooth boundary.
C 1	8-16"	Light brownish gray (10YR6/2) loamy sand, dark brown (10YR3/3) moist; massive; slightly hard, friable, nonsticky, nonplastic; abundant very fine, abundant fine and plentiful medium roots; noneffervescent; clear smooth boundary.
R 1	16-26"+	Pale brown (10YR6/3) loamy sand, dark yellowish brown (10YR4/4) moist; massive; hard, firm, nonsticky, nonplastic; few very fine and plentiful fine roots; paralithic contact with weathered sandstone.

APPENDIX B-16

Very fine, montmorillonitic, frigid family of Typic Argixerolls

Typically these soils have a 10-inch mollic epipedon over and in conjunction with a strong medium prismatic, heavy clay argillic horizon. Reaction of the solum increases with depth and ranges from slightly acid to neutral.

These soils are usually found at elevations from 5700 to 6300 feet and are associated with the *Artemisia tridentata/Carex* sp./ *Bromus tectorum* and *Chrysothamnus viscidiflorus/Poa secunda* communities. They are found on east and west facing slopes of 8 to 35 percent. The macrorelief is hilly and the microrelief is uniform convex and uniform concave. These soils belong to the D hydrologic group and have a profile available water holding capacity of 5.2 inches. Stoniness class is 0. The majority of the roots are found within 20 inches of the soil surface. There is no erosion evident.

A 1	0-8"	Grayish brown (10YR5/2) sandy clay loam, very dark grayish brown (10YR3/2) moist; moderate fine platy; slightly hard, friable, slightly sticky, slightly plastic; abundant very fine, abundant fine and plentiful medium roots; organic matter 1.5 percent, conductivity 0.2 mmhos., cation exchange capacity 8.3 meq.; noneffervescent; slightly acid (pH 6.1); abrupt smooth boundary.
B2t	8-26"	Dark brown (10YR3/3) moist; heavy clay; strong medium prismatic; extremely hard, extremely firm, very sticky, very plastic; few very fine, plentiful fine and few medium roots; organic matter 0.7 percent, conductivity 0.2 mmhos.; noneffervescent; neutral (pH 7.0); clear smooth boundary.
B3	26-30"+	Brown (10YR4/3) moist; light clay; massive; hard, firm, very sticky, very plastic; few fine roots; violently effervescent.

PLANT COMMUNITIES AND SOILS ASSOCIATION TABLE FOR THE CRANE SPRINGS WATERSHED

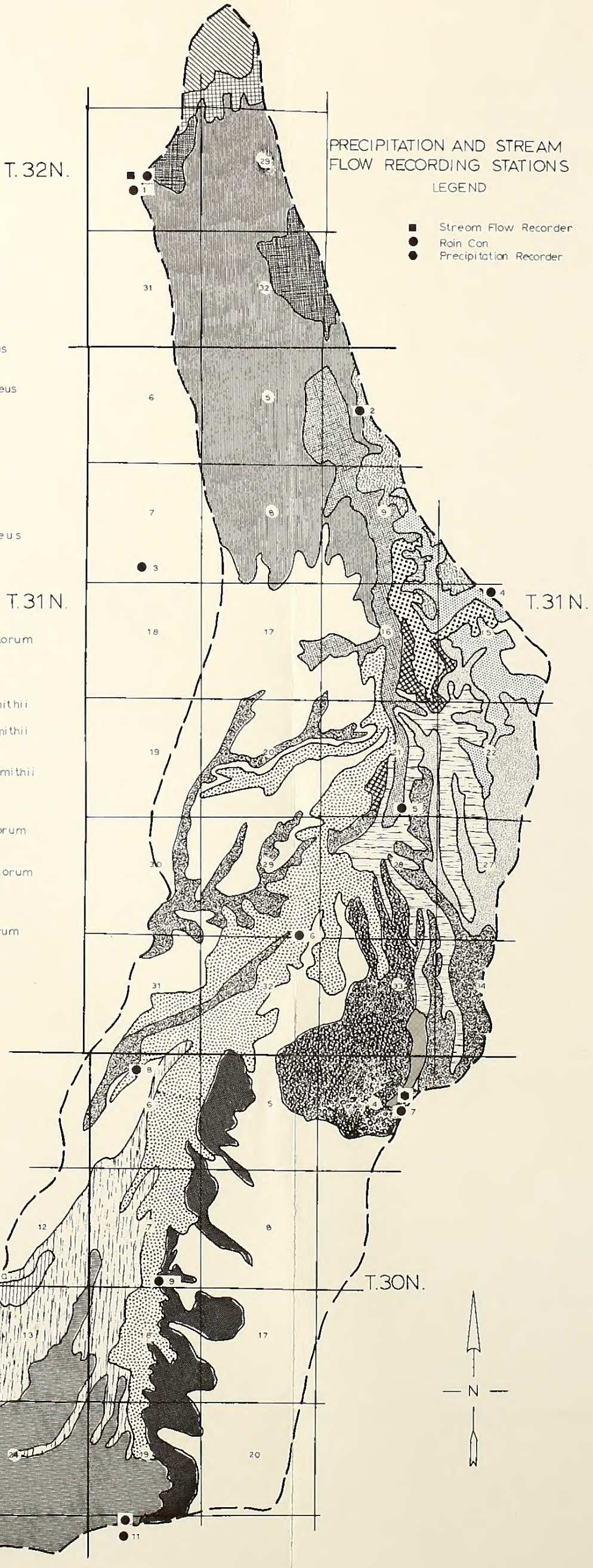
	Torripsamments		Torriorthents	Calciorthids		Camborthids					Durorthids	Haplargids		Palegargids	Haploxerolls	Argixerolls
COMMUNITIES / SOILS	Sandy-skeletal, mixed, frigid, shallow family of Typic Torripsamments	Sandy, mixed, frigid family of Typic Torripsamments	Coarse-loamy, mixed, frigid family of Typic Torriorthents	Loamy-skeletal, mixed, mesic family of Mollic Calciorthids	Coarse-loamy, mixed, mesic family of Mollic Calciorthids	Loamy-skeletal, mixed, frigid family of Duric Mollic Camborthids	Coarse-loamy, mixed, frigid family of Duric Mollic Camborthids	Loamy-skeletal, mixed, frigid family of Mollic Camborthids	Coarse-loamy, mixed, mesic family of Mollic Camborthids	Coarse-loamy, mixed, frigid family of Mollic Camborthids	Coarse-loamy, mixed, frigid family of Entic Mollic Durorthids	Loamy-skeletal, mixed, mesic family of Lithic Mollic Haplargids	Fine-loamy, mixed, frigid family of Duric Mollic Haplargids	Very-fine, montmorillonitic, frigid family of Mollic Palegargids	Sandy, mixed, frigid, shallow family of Entic Haploxerolls	Very-fine, montmorillonitic, frigid family of Typic Argixerolls
Artemisia arbuscula/ Poa secunda														X		
Artemisia nova/ Bromus tectorum												X				
Artemisia tridentata/ Bromus tectorum		X	X				X		X	X			X			
Artemisia tridentata/ Bromus tectorum		X	X				X		X	X			X			
Artemisia tridentata/Carex sp./ Bromus tectorum																X
Artemisia tridentata/Chrysothamnus viscidiflorus/Elymus cinereus							X									
Artemisia tridentata/Chrysothamnus viscidiflorus/Poa secunda		X					X									
Artemisia tridentata/Elymus cinereus/Bromus tectorum							X			X						
Artemisia tridentata/Poa secunda/Elymus cinereus											X					
Atriplex confertifolia/ Bromus tectorum				X	X											
Chrysothamnus viscidiflorus/ Agropyron smithii/Elymus cinereus							X									
Chrysothamnus viscidiflorus/ Elymus cinereus		X														
Chrysothamnus viscidiflorus/ Poa secunda																X
Juniperus osteosperma	X															
Juniperus osteosperma/Artemisia nova/Bromus tectorum												X				
Juniperus osteosperma/Chrysothamnus viscidiflorus/Agropyron smithii		X														
Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum						X		X							X	

CRANE SPRINGS WATERSHED

VEGETATION MAPPING UNITS AND PRECIPITATION, STREAM FLOW RECORDING STATIONS

VEGETATION MAPPING UNITS
LEGEND

Symbol	%	
	100	Artemisio novo/Bromus tectarum
	100	Artemisio triden tata/Bromus tectorum
	50	Artemisia tridentato/Bromus tectorum
	50	Atriplex confertifolio/Bromus tectorum
	95	Artemisio tridentoto/Corex sp. /Bromus tectorum
	5	Artemisio orbusculo/Poa secundo
	65	Artemisio tridentato/Chrysothamnus viscidiflorus/Elymus cinereus
	35	Chrysothamnus viscidiflorus/Elymus cinereus
	60	Artemisio tridentato/Chrysothamnus viscidiflorus/Elymus cinereus
	40	Artemisia tridentato/Elymus cinereus/Bromus tectorum
	100	Artemisio tridentoto/Chrysothomnus viscidiflorus/Poo secunda
	70	Artemisio tridentoto/Chrysothomnus viscidiflorus/Poo secundo
	25	Chrysothamnus viscidiflorus/Poa secundo
	5	Artemisia tridentato/Poo secundo/Elymus cinereus
	100	Artemisio tridentata/Elymus cinereus/Bromus tectorum
	100	Chrysothomnus viscidiflorus/Agropyron smithii/Elymus cinereus
	100	Juniperus osteospermo
	80	Juniperus osteosperma
	20	Chrysothomnus viscidiflorus/Elymus cinereus
	70	Juniperus osteospermo
	15	Juniperus osteospermo/Chrysothomnus viscidiflorus/Bromus tectorum
	15	Artemisio tridentoto/Chrysothomnus viscidiflorus/Poo secundo
	100	Juniperus osteospermo/Artemisio novo/Bromus tectorum
	100	Juniperus osteospermo/Chrysothomnus viscidiflorus/Agropyron smithii
	70	Juniperus osteospermo/Chrysothomnus viscidiflorus/Agropyron smithii
	30	Chrysothomnus viscidiflorus/Elymus cinereus
	60	Juniperus osteospermo/Chrysothomnus viscidiflorus/Agropyron smithii
	30	Artemisio tridentata/Chrysothomnus viscidiflorus/Poo secundo
	10	Juniperus osteosperma
	65	Juniperus osteospermo/Chrysothomnus viscidiflorus/Bromus tectorum
	35	Artemisio tridentoto/Chrysothomnus viscidiflorus/Poo secundo
	60	Juniperus osteospermo/Chrysothomnus viscidiflorus/Bromus tectorum
	30	Artemisio tridentoto/Chrysothomnus viscidiflorus/Poo secunda
	10	Juniperus osteospermo
	60	Juniperus osteospermo/Chrysothomnus viscidiflorus/Bromus tectorum
	25	Artemisio tridentoto/Chrysothamnus viscidiflorus/Poo secundo
	15	Chrysothamnus viscidiflorus/Poa secundo



SCALE 1:63,360

1 .5 0 1 2Miles

ROAD
LEGEND
===== Unimproved Dirt

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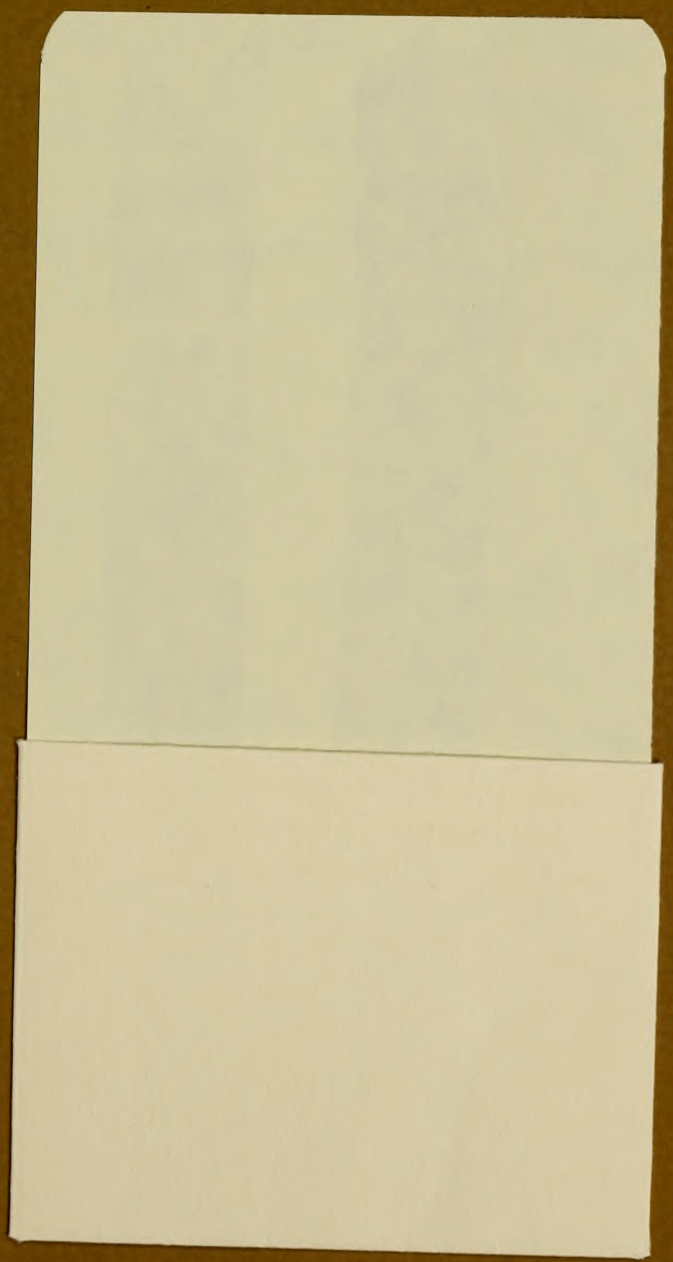
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